MULTIEMPLOYER DEFINED BENEFIT PENSION PLANS' LIABILITY SPILLOVERS: IMPORTANT CONNECTIONS IN U.S. UNIONIZED INDUSTRIES

by

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ABSTRACT

A multiemployer defined pension plan (MDBP) is a collectively bargained pension plan maintained by two or more employers and a labor union. MDBPs pool risks, contributions, assets, and liabilities. Bankruptcy by MDBP firms usually results in almost constant MDBP total liabilities but a shrinking pool of contributing MDBP employers, thus increasing MDBP liabilities for the remaining MDBP employers and exposing them to "liability spillover risks." I document the economic magnitudes of public firms' MDBP liabilities and MDBP liability spillovers from other public companies, information relevant to both finance academics and policy makers. I find five companies with 5-year expected MDBP liability spillovers exceeding 1% of their book assets. One company has 1-year expected MDBP liability spillovers exceeding 22% of its book assets. On average, leverage ratios increase by 6% once MDBP liabilities and expected liability spillovers are consolidated into capital structure. I investigate empirically whether the risk associated with MDBP membership is systematic and is priced. I propose that MDBP sharing companies share four common risks: MDBP liability spillover risks, MDBP unfunded liability risks, labor contract risks, and geographic area risks. To test for common effects on stock returns, I regress public MDBP firms' stock returns on known risk factors and extract the residuals and then regress the residuals against an equally weighted index of stock returns of companies with whom the firm shares MDBPs. I find that MDBP sharing companies' stock retur

display positive statistically significant excess co-movement. Using an equally weighted MDBP index, I find statistical evidence to suggest that MDBP sharing firm's co-movement changes after the public release of information about which firms share MDBPs.

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CHAPTER 1

MULTIEMPLOYER DEFINED BENEFIT PLANS' LIABILITY SPILLOVERS

1.1 Introduction

A multiemployer pension plan is a collectively bargained pension plan maintained by two or more employers, frequently within the same or related industries, and a labor union. Fifty-two percent of private-sector multiemployer pension plans are defined benefit plans whereas only 6% of private-sector single-employer pension plans[1] are defined benefit plans. U.S. active private-sector multiemployer defined pension plans (MDBPs) have one-third of the participants, one-quarter of the assets but only 3% of the number of private-sector single employer defined benefit pensions (SDBPs). Therefore, the average MDBP has assets seven times larger than the average SDBP. For the 2010 plan year, there were 1,471 U.S. active private-sector MDBPs with 10.6 million participants and $466 billion assets as compared to 45,072 U.S active private-sector SDBPs with 30.8 million participants and $1,982 billion assets (U.S. Department of Labor Employee Benefits Security Administration, 2012). Although in aggregate, SDBPs have a larger asset base than MDBPs, unprecedented levels of MDBP underfunding together with MDBP ability to

[1] Includes single employer plans, plans of controlled groups of corporations and multiemployer non-collectively bargained plans.

produce liability spillovers amongst its participant companies makes MDBPs a unique and important area for financial research. This chapter aims at providing a detailed description of the structure of MDBPs and constructing MDBP liability spillover measures. Upon reviewing the structure of MDBPs, it becomes evident that spillover risk is relevant. This chapter provides insights into both MDBP liability spillover risks' magnitude and economic significance.

MDBPs exist predominately to allow employees in transient industries such as construction, retail, hotels and entertainment to keep and continue earning pension credits when changing jobs but still working for participating employers in the same MDBP; average tenure in MDBP industries is often shorter than 3 to 5 years required to vest SDBP pension benefits. A joint board of trustees, equally representing labor and employers, govern MDBPs (Introduction to Multiemployer Plans, 2013). Unlike SDBP liabilities, MDBP liabilities are not mandatorily reported on public companies' balance sheets, a feature which may help to explain MDBPs' existence, but also makes the plans opaque to investors.

MDBPs pool risks, contributions, assets, and liabilities. Companies may withdraw from MDBPs by paying their share of the plan's unfunded vested benefits, but frequently MDBP withdrawal liabilities are greater than the company's share of the MDBP's unfunded liabilities[2] (Moody's, 2009) and withdrawal may be difficult without the agreement of the company's unionized employees (Sanders, 2011). In the case of bankruptcy, MDBP withdrawal liabilities are general unsecured claims. Bankruptcy by

[2] MDBP withdrawal liabilities must cover the whole of the company's share of the MDBP underfunding. When a firm continues in a MDBP, the MDBP employee participants bear some of the burden of funding underfunded MDBPs by relinquishing current wages, benefits or work rules (Moody's (2009)).

MDBP firms results in essentially constant MDBP total liabilities[3] but a shrinking pool of contributing MDBP employers, thus increasing MDBP liabilities for the remaining MDBP employers. The Pension Benefit Guarantee Corporation (PBGC) intervenes only when MDBPs become insolvent (unable to pay current benefits out of plan resources), whereas PBGC takes over any SDBP terminated during the employer's bankruptcy. Through the mechanism described above, MDBPs expose their participant employers to "liability spillover risks" from other employers in the same MDBP.

Narrative evidence suggests that MDBP employers are indeed concerned with "MDBP liability spillover risks." In a letter to The US Congress dated July 13, 2010, MDBP employers expressed their concerns,

> Because of the nature of multiemployer plans, when one employer goes bankrupt, the remaining employers in the plan become responsible for paying the accrued benefits of all the workers—this is often referred to as "last man standing." As the number of employer participants dwindles, employers remaining in the plan see their liabilities increase exponentially—forcing them to cover retirees that never worked for them… Without a real resolution to this problem, more employers will be forced into bankruptcy and more workers will be left without a secure retirement. (Employers, Multiemployer Plan; Organizations, Employer, 2013, p. 1)

Sanders (2011) describes how employer associations exist in MDBP industries in order to promote employers' interests in negotiations with the unions. MDBPs are a mandatory part of the multiemployer bargaining process whereby an employer association representing competing companies will agree with a single union to one solitary collective bargaining agreement (CBA). The portability of multiemployer pensions and healthcare

[3] Anecdotal evidence suggests that in many cases MDBPs recover a small percentage of their unsecured withdrawal liability claims. Judy McReynolds, President and CEO of Arkansas Best Corporation testified in front of the United States House Committee on Education and Workforce Subcommittee on Health, Employment, Labor and Pensions on June 20, 2012,"Many withdrawals have occurred in the bankruptcy context, and plans typically collect only pennies on the dollar of the withdrawal liabilities owed by these bankrupt or defunct companies." http://edworkforce.house.gov/uploadedfiles/06.20.12_mcreyolds.pdf

plans weakens the power of any one employer over unionized employees. Unions demand that their members belong to the same MDBP especially across the same geographical area and if the majority of employers in the employer association want to continue the MDBP, the employer association will bargain to continue the MDBP. Sanders describes how the multiemployer bargaining structure promotes the interests of the industry's leading employers by creating an anticompetitive cartel whose rents are shared with the unions in the form of higher wages and benefits and whose weapons for policing the employer association's membership include MDBPs.

At first glance, given the many curious features of MDBPs, one wonders why MDBPs originated and why MDBPs still exist. The most pertinent question is: Why do large credit-worthy firms belong to MDBPs together with smaller less credit-worthy firms? More credit-worthy MDBP employers may be compensated for providing essentially free insurance to less credit-worthy MDBP employers by the ability to offer lower salaries and benefits package in return for providing portable pensions to their transient employees and/or, as Sanders (2011) argues, extracting customer rents. The question of why MDBPs originated is far easier to answer. MDBPs first appeared in the late 1930s and 1940s in order to provide pension benefits to the unionized workforce in transitory employment or who worked for small employers (Segal, 2007). Before 1980, employers could share pension administrative costs and pool employees' longevity risk without exposure to MDBP withdrawal liabilities. Moreover, risk pooling ensured that MDBP employees' retirement benefits were less threatened by an individual employer's financial difficulties than SDBP employees' retirement benefits.[4]

[4] The PBGC began insuring SDBP retirement benefits in 1974.

In this chapter, I provide economic analysis of U.S. MDBPs, a little known but economically important part of the U.S. pension system. While single-employer defined benefit pension plans have taken the spotlight, there is almost no academic or practitioner research on MDBPs. I document the economic magnitudes of public firms' MDBP liability spillovers from other firms with whom the firm shares MDBPs, information relevant to both finance academics and policy makers. I examine two cases, first "last man standing" (LMS hereafter) MDBP liability spillovers where I assume all private and public major contributing companies go bankrupt except the company for whom I calculate LMS MDBP liability spillovers and second expected MDBP liability spillovers from other major contributing public firms.

My dissertation makes several important contributions concerning MDBPs. First, I provide the first comprehensive quantification of MDBP liability spillovers. Second, my research increases the understanding of default correlation amongst public U.S. firms that contribute to MDBPs, an understanding which is essential for firms and investors who seek to diversify their exposure to correlated risks. Finally, and most importantly, my research can inform the PBGC's simulation models and therefore U.S. policy makers.

More informed PBGC simulation models minimize the risk of taxpayers providing funds to an insolvent PBGC. The PBGC only covers MDBP participants' pensions up to an annual maximum of $12,870 as opposed to an annual maximum of $57,480 for SDBP participants' pensions. The PBGC's 2012 report noted that the multiemployer insurance program had liabilities of $7 billion and assets of $1.8 billion and estimates that by 2022 the multiemployer insurance program will have a mean deficit of $32 billion. Mitchell (2013) points out that multiemployer insurance program costs may pose more risk to the

PBGC than single employer plan insurance underfunding. The Congressional Budget Office projects that the PBGC will run out of money in 7 years. PBGC Director Josh Gotbaum commented, "If Congress allows the PBGC to get the money and the authority it needs to do its job, then these [multiemployer] plans can be preserved," he added, "If not, the PBGC will run out of money, too, and multiemployer pensioners will get virtually nothing. This is not something that can wait a few years. If people kick the can down the road, they'll find it went off a cliff" (Williams Walsh, 2014). My research documents LMS MDBP liability spillovers onto public companies and expected MDBP liability spillovers amongst MDBP public companies informing PBGC's estimation of MDBP company bankruptcy probabilities.

In my dissertation, I exploit the 2009 and 2010 plan year MDBP Form 5500 Schedule R filings to calculate and expected MDBP liability spillovers from publicly available information. MDBPs file Form 5500 with the Department of Labor (DOL) to satisfy the Employee Retirement Income Security Act of 1974 (ERISA) and Internal Revenue Code annual reporting requirements. For the 2009 plan year, for the first time, MDBPs made mandatory disclosures on Form 5500 Schedule R about employers making more than 5% of the total plan year contributions. MDBPs filed their 2009 Form 5500s between June 2010 and August 2011. Prior to 2012, few companies disclosed in their public filings the names of their MDBPs[5]; therefore, for the vast majority of 2009 Form 5500 Schedule R filing released new public information about companies contributing the same MDBP. The new information consisted of the employer's name, the employer identification number (EIN), the employer's annual contribution, CBA expiration date(s),

[5] Some notable exceptions are Arkansas Best and YRC Worldwide who both disclosed in their 10-Ks that they were major contributors to the Central States, Southeast and Southwest Areas Pension Fund.

and contribution rate information. Plan administrators filed the 2009 plan information electronically[6] and the public could view the MDBP's Form 5500 filings through the DOL Website (www.efast.dol.gov) or in the Washington public disclosure room within 24 hours of the DOL's filing receipt.[7]

For the 2009 plan year, the average MDBP company (out of 131) has a 2.6 times larger market capitalization, is 40% more levered, and has a lower market to book ratio than the average Compustat company (out of 3,369). In aggregate, 154 public companies are responsible for $23.9 billion Schedule R MDBP liabilities; hereafter I refer to Schedule R MDBP liabilities as MDBP liabilities.[8] The transportation sector accounts for half (51.8%) of the aggregate MDBP liabilities and the food/retail sector accounts for 29% of the aggregate MDBP liabilities.

I calculate LMS MDBP liability spillovers where I assume that all Schedule R companies go bankrupt except for the public Schedule R company for whom I calculate the LMS MDBP liability spillovers. Eight companies have LMS MDBP liability spillovers larger than 10% of their book assets and 31 companies have LMS MDBP liability spillovers larger than 1% of their book assets.

Five firms have 5-year expected MDBP liability spillovers from other public companies bigger than 1% of their market value of equity. Sixteen public companies have 1-year expected MDBP liability spillovers from other public companies larger than 0.1% of their market value of equity. For these 16 companies, the mean 1-year expected MDBP

[6] From January 2010, all pension and welfare plans had to file Form 5500 electronically using the EFAST2 system.
[7] http://www.dol.gov/ebsa/faqs/faq-EFAST2.html: Questions 42 and 43.
[8] Public Companies may have non-Schedule R liabilities when the company contributes less than 5% of the total contributions to a MDBP with unfunded liabilities.

liability spillovers as a percentage of market value of equity is 7.3% (median 0.4%) and the mean 1-year expected MDBP liability spillovers as a percentage of total assets is 1.9% (median 0.2%). Three companies have extremely large 1-year expected MDBP liability spillovers as a percentage of their market value of equity: Great Atlantic and Pacific Tea Company (74.8%), Arkansas Best Corp (32.0%), and YRC Worldwide (5.6%), generating severe positive skewness in the distribution of 1-year expected MDBP liability spillovers as a percentage of market value of equity.

I calculate expected MDBP liability spillovers over a 1-year period and a 5-year period. On average, firm 5-year expected MDBP liability spillovers are 2.6 times larger than firm 1-year expected MDBP liability spillovers. My calculations reveal that expected MDBP liability spillovers from other public companies is not an issue for the majority of public MDBP companies. However my calculations do not include expected MDBP liability spillovers from private and non-Schedule R public companies or account for default correlation amongst MDBP companies.

Other Schedule R public companies, Schedule R private companies, and non-Schedule R companies expose public Schedule R Companies to MDBP liability spillovers. In my sample, on average, other public Schedule R companies' liabilities account for just 16.3% (median 7.4%) of the total liabilities from all three sources. Therefore, my calculated expected MDBP liability spillovers are most likely a small percentage of the total expected MDBP liability spillovers. On the other hand, companies usually share MDBPs with companies in the same industry and my expected MDBP liability spillover calculations do not account for positive competitive effects in the event of bankruptcy.

Aggregate 1-year expected MDBP liability spillovers revealed to market

participants by Form 5500 filings peaked at the end of April 2011 at $558.0 million, the $217.7 million expected MDBP liability spillover from YRC Worldwide onto Arkansas Best accounted for 39% of the aggregate expected spillover, the food/retail sector for one third (33.8%) of the aggregate spillover and the mines/coal/oil sector for 11.7% of the aggregate spillover. Expected MDBP liability spillovers exist primarily between companies in the same broad industry group. At the end of April 2011, on average 95.3% of expected 1-year MDBP liability spillovers arose from companies within the same broad industry group.

Hostess Brands filed for bankruptcy on January 11, 2012 blaming troubles with its pension and medical benefits obligations, increased competition and economic conditions (Newspaper Article: Twinkies maker Hostess seeks bankruptcy protection, 2012). Eight MDBPs were listed amongst Hostess's top 10 unsecured creditors. Hostess's largest unsecured claim for $944 million was from Bakery and Confectionary Union and Industry International Pension Fund. Bishop (2013) reports,

> Bimbo Bakeries USA [which shared many MDBPs with Hostess] objected Thursday to attempts by Hostess Brands Inc. to use its bankruptcy case to pull out of 24 multi-employer pension funds, saying Hostess's $2 billion pension obligations would be unfairly dumped onto Bimbo and other employers. The Grupo Bimbo SAB subsidiary claims that if the other contributing employers are unable to withstand the financial impact of Hostess's avoidance of its fiscal obligations to the funds, smaller competitors may become insolvent, and the funds themselves may suffer "catastrophic failure," causing severe harm to employees and retirees. Moreover, even if the funds survived, Bimbo would end up shouldering a significant portion of Hostess's unpaid withdrawal liability, driving up its own costs, both current and contingent, according to its objection. (p. 1)

This case highlights that private company MDBP liability spillovers can be large and my documented public company MDBP expected liability spillovers are most likely a small percentage of total expected MDBP liability spillovers from both public and private

companies.

Although the academic finance literature has paid little attention to MDBPs, unfunded MDBP liabilities are potentially relevant in assessing corporate securities. Rating agencies view a company's share of MDBP unfunded liabilities as a debt-like company liability (Moody's, 2006) and since 2006, rating agencies have incorporated estimates of unfunded MDBP liabilities into the information they use to rate bond issues. In March 2012, a Credit Suisse equity research report estimated that U.S. MDBPs are in aggregate 52% funded. MDBPs have more than one contributing employer therefore underfunded MDBPs result in expected MDBP liability spillovers. Zion, Varshney, and Burnap (2012) comment,

> With the plans in bad shape, the companies that have multiemployer exposure could get hit from a number of angles, including increased contributions to the plans resulting in a drain on cash flows and a hit to earnings. Withdrawal liabilities could increase too, driving up the price of pulling out of a multiemployer pension plan. It may even impact M and A as an acquirer is going to pay less (all else equal) for a company with heavy exposure to underfunded multiemployer plans. In addition, as the multiemployer exposure becomes clearer, investors may decide that certain companies are more expensive than they initially appear after factoring in this off-balance-sheet liability. Even credit ratings could be impacted if the ratings agencies are able to gain new insight about a company's share of multiemployer underfunding and its impact on future cash flows. (p. 2)

MDBPs' unique institutional features generate numerous unexplored financial effects. In my dissertation, I focus on MDBP liability spillovers but as Credit Suisse highlights, MDBPs have far reaching financial implications. Previously, little information was available on companies' MDBP exposure. However, the new schedule R information together with the new 10-K "significant" MDBP disclosures have drastically improved information on companies' MDBP exposure, providing a fertile area for financial research.

The remainder of this chapter is organized as follows. Section 1.2 presents a

literature review. Section 1.3 describes MDBP institutional details. Section 1.4 describes the data collection, MDBP unfunded liability calculations, and LMS and expected MDBP liability spillover calculations. Section 1.5 explains how I incorporate MDBP unfunded liabilities and 1-year expected MDBP liability spillovers into leverage calculations. Section 1.6 describes the MDBP public company sample selection. Section 1.7 describes MDBP characteristics and public company MDBP liabilities. Section 1.8 summarizes public company LMS MDBP liability spillovers and expected MDBP liability spillovers and summarizes the public company expected MDBP liability spillover information available to market participants from Form 5500 filings from July 2010 through November 2011. Section 1.9 concludes.

1.2 Literature Review

My research is related to three strands of literature: default correlation, contagion effects, and research on SDBPs. My study is primarily related to the financial distress contagion literature.

All else equal, expected MDBP liability spillovers increase a firm's own default probability and increase correlations amongst MDBP sharing firm's default probabilities. Merton (1974) models equity as a call option on a firm's assets with the call's exercise price equal to the value of the firm's liabilities; when an under-funded MDBP firm files for bankruptcy, the MDBP liabilities of other firms in the same MDBP increase. This essentially increases the nonbankrupt MDBP firm asset call option's exercise price and decreases equity value.

Jarrow and Yu (2001) define counterparty risk as the risk that the default of a firm's

counterparty might affect its own default probability and introduce counterparty risk to Lando's (1994, 1998) reduced form model[9] by adding a jump process to the set of state variables. MDBP liability spillover risks are "looped" because companies in the same MDBP are all exposed to each others' MDBP liabilities when participant companies file for bankruptcy. Jarrow and Yu model a two company looping default and show that counterparty risk nonlinearly increases default probability.

Traditional default models using macroeconomic common factors fail to produce levels of default clustering observed in data (Das, Duffie, Kapadia, & Saita, 2007). Jorion and Zhang (2009) show that counterparty risk increases a company's own default probability. Using simulation, the authors analyze defaults of 500 companies generated first by a conventional factor model (LMS 1-year default probability of 1% and a 0.20 pair-wise default correlation coefficient) and then by adding counterparty risk to the baseline model (three counterparties for each company with a 30% debt recovery rate). With counterparty risk, the default correlation increases to 0.0262 from a baseline default correlation of 0.0243. Furthermore, the simulation results support the hypothesis that counterparty risk contributes to the fat tails observed in default distributions. With counterparty risk, the default distribution's 99.99th percentile increases from 115 to 127 defaults.

MDBP liability spillover risks share many characteristics with counterparty risks, and MDBP bankrupt companies can increase the liabilities of companies with whom they share MDBPs, thus increasing the bankruptcy correlation amongst MDBP sharing companies. My research documents public companies' expected MDBP liability spillovers

[9] Lando's model uses a doubly stochastic Poisson process to account for the dependency between credit and market risk.

and documents an additional source of U.S. company financial distress contagion namely expected MDBP liability spillovers.

Generally, an individual MDBP covers unionized employees in the same industry. Therefore, companies who share MDBPs are often competitors. Lang and Stulz (1992) find that on average the market value of a value-weighted portfolio of the bankrupt firm's competitors' common stock declines by a statistically significant 1% at the time of the bankruptcy announcement. The authors define the contagion effect as the change in value of competitors that cannot be attributed to the bankrupt firm's wealth distribution and define the competitive effect as the wealth gain experienced by competitors because the bankruptcy conveys information about the competitive positions of firms in the bankrupt firm's industry. The authors find evidence of both a contagion effect and a competitive effect amongst their results. For industries with a debt-to-asset ratio exceeding the sample median, they find the value of the competitors' equity falls by 3% on average, providing evidence that for these firms the contagion effect dominates, whereas, in less competitive industries[10] with low leverage competitors' equity increases by 2.2%, providing evidence that for these firms the competitive effect dominates.

Hertzel, Li, Officer, and Rodgers (2008) find significant contagion effects for suppliers of bankruptcy filing firms in both the filing period and prefiling distress period; furthermore, they find more severe significant supplier contagion effects when the bankruptcy filing firm's industry experiences contagion effects. The authors find that the average filing-period abnormal return for supplier portfolio is -1.94%; this abnormal return decreases to -4.76% when the authors restrict the sample to bankruptcy firms where the

[10] Less competitive industries are defined as industries where the Herfindahl index (a proxy for imperfect competition) is less than the sample median.

bankruptcy filing firm's industry experiences contagion effects.

Jorion and Zhang (2009) provide empirical evidence that counterparty risk is an important credit contagion mechanism. The authors examine unsecured creditors' abnormal stock returns and credit default swap (CDS) spread changes around bankruptcy events and document an average 11-day window industry-adjusted cumulative abnormal return (CAR) of -2.29% for 230 industrial creditors.[11] The authors find that within two years of the bankruptcy filing, 2.60% of credit rated industrial creditors are delisted, whereas only 0.56% of matched control sample firms are delisted; the difference in population percentages is statistically significant from zero at the 1% level. Furthermore, 32.32% of credit rated industrial creditors are downgraded within 2 years of the bankruptcy event in comparison to only 12.36% of matched control sample firms; the difference in population percentages is statistically significant from zero at the 1% level. Vassalou and Xing (2004) explain that default risk contagion effects may result in a systematic component to default risk. Using Merton's (1974) model to measure default risk, the authors find that default risk is systematic; specifically, they add the change in aggregate survival rate[12] as an explanatory variable to CAPM and three-factor Fama and French (1993) regressions and find that the change in aggregate survival rate has a positive and significant risk premium.

Shivdasani and Stefanescu (2010) show that public firms' leverage ratios are about 35% higher when SDBPs are brought back onto the balance sheet. The authors find that on average, the tax benefits from SDBPs account for about 1.5% of the value of the firm.

[11] Trade credit accounts for 98% of the debts owed to industrial creditors.
[12] Survival rate is defined as one minus the probability of default. Change in survival rate is defined as survival rate at time t minus the survival rate at time t-1.

The authors do not examine MDBPs.

1.3 MDBP Institutional Background

1.3.1 Employer and Employee MDBP Advantages

MDBPs provide advantages to both employers and employees. The International Foundation of Employee Benefit Plans highlights the many advantages of MDBPs: Mobile employees earn and retain their benefits when working for various participating employers in the same MDBP. The centralized plan administration increases benefits and/or reduces participating employer costs. Employers' risk and resources are pooled and accordingly MDBPs pay much lower insurance premiums to the PBGC than SDBPs. Multiemployer plans have access to investment and consulting advice which would be cost prohibitive for smaller plans. Employer MDBP contributions are tax deductible (International Foundation of Employee Benefit Plans, 2013).

1.3.2 Valuing MDBP Liabilities

MDBP liabilities are obscure and difficult to value. Unlike SDBP liabilities, aggregate MDBP liabilities are not recorded on public company balance sheets, and actuaries, rating agencies and financial services companies use different interest rates to discount MDBP liabilities. In contrast to SDBP actuaries who for funding purposes must use interest rates based on current investment grade corporate bond yields to discount pension liabilities, MDBP actuaries may use the valuation rate, an interest rate that reflects long term expectation of investment earnings given the plan's investment structure to discount pension liabilities (McGill, Brown, Haley, Schieber, & Warshawsky, 2010). Zion

et al. (2012) find that the median valuation rate for the 2010 MDBP year was 7.5% whereas the median 2011 discount rate for SDBP liabilities for S&P 500 companies was 4.7%. Therefore MDBP liabilities would be larger if they were discounted at the SDBP discount rate.

1.3.3 Withdrawal Liability

MDBPs are governed by The 1974 Employee Retirement Income Security Act (ERISA); in 1980, Congress passed the Multiemployer Pension Plan Amendments (MPAA) which introduced a withdrawal liability. Employers who wish to withdraw from a MDBP must pay their share of the plan's unfunded vested pension benefits. Withdrawal liabilities can be paid as a lump sum or paid over a period, generally up to 20 years with interest. Solvent employers may withdraw voluntarily from a MDBP by paying a withdrawal liability. Plant closures, rejection of CBAs and redundancies can all trigger compulsory withdrawal liabilities for solvent employers. When an employer's contribution base shrinks by at least 70%, employers must pay a partial withdrawal liability. A MDBP only files a claim during a chapter 11 bankruptcy if the employer withdraws from the MDBP prior to the bankruptcy filing or during the bankruptcy process. If an employer is insolvent and undergoing liquation or dissolution when it withdraws, 50% of the withdrawal liability is contingent on whether there is sufficient liquidation or dissolution value after all the other employer's debts are paid (Mazo & Lee, 2010).

ERISA requires that the computation of a MDBP's withdrawal liability is based on the actuary's best estimate of anticipated experience under the plan and reasonable assumptions. When calculating withdrawal liabilities, plan actuaries use the valuation rate

or a blended rate, which is a weighted average of the valuation rate and the PBGC annuity purchase rate,[13] to discount vested pension liabilities (Mazo & Lee, 2010). The PBGC January 2010 annuity purchase rate was 4.89% for the first 20 years and 4.63% thereafter, respectively. In the event of a "mass withdrawal" (all employers or "substantially all" withdrawing from a plan) withdrawal liability calculations use vested liabilities discounted with the PBGC annuity rate and the market value of plan assets, whereby stocks are valued using stock market prices and bonds are priced using market prices and discounted cash flow analysis.

MDBP actuaries use different valuation methods to calculate withdrawal liabilities. The Segal Company, a prominent MDBP consulting actuarial firm, calculates withdrawal liabilities using a blended discount rate and the market value of plan assets for the Laborers Pension Trust Fund for Northern California in a report dated May 31, 2011. Segal actuaries discount 40.9% (market value of assets divided by vested liabilities discounted with the PBGC annuity rate) of the vested pension liabilities at the PBGC annuity rate and discount the remaining vested pension liabilities at the 7.5% valuation (The Segal Group Inc, 2013). In contrast, the Steelworkers Pension Trust (Steelworkers Pension Trust Explanation of Withdrawal Liability, 2013) calculates withdrawal liabilities using the valuation discount rate (7.25%) and the Indiana teamsters' pension fund actuarial report dated January 1, 2012, assesses withdrawal liabilities using a valuation discount rate (7.25%) and the smoothed actuarial value of the plan assets (United Actuarial Services, 2013).

Anecdotal evidence suggests that it may be optimal for credit worthy companies to withdraw from poorly funded MDBPs when they share the plan with other less credit

[13] The PBGC annuity purchase rate is the interest rate used to value MDBP benefits and certain assets following a contributing employer mass withdrawal. http://www.pbgc.gov/prac/interest/ida.html.

worthy companies. United Parcel Services (UPS) withdrew from the Central States, Southeast and Southwest Areas Pension Fund (Central States hereafter) at the end of 2007. At the time, UPS was the biggest contributor to the Central States with Arkansas Best and YRC Worldwide the other major contributors to the plan. The Central States was 60.5% funded as of November 1, 2005. At the end of 2007, Standard and Poor's rated UPS' long term bonds AAA, several notches above Arkansas Best bonds' BBB+ rating and YRC Worldwide bonds' BBB- rating. UPS paid a $6.1 billion pretax withdrawal payment to the Central States and set up a new UPS plan for its employees formperly covered by the Central States. More recently, on September 16, 2012, UPS withdrew from the 41.4% funded New England Teamsters and Trucking Industry Pension Fund, incurring a $1.2 billion withdrawal liability. The above UPS examples illustrate that companies will optimally exercise the real option to withdraw from a MDBP when the MDBP is seriously underfunded and they share the MDBP with less credit worthy companies than themselves. Realized MDBP withdrawal liabilities are recorded as contingent liabilities in a company's financial statements.

1.3.4 MDBP Partition

MDBP partition occurs when the PBGC separates the liabilities and equitable assets of bankrupt companies' plan participants into a new plan and the liabilities and equitable assets of nonbankrupt companies' plan participants into another new plan. ERISA Section 4233 allows the PBGC to partition a MDBP under very specific circumstances:

1. The bankruptcy of contributing employer(s) will or has resulted in a substantial reduction in the aggregate contributions to the MDBP;

2. The MDBP is likely to become insolvent[14];
3. Contributions will have to be increased significantly in plan reorganization to meet the minimum contribution requirement and prevent insolvency; and
4. Partition will significantly reduce the likelihood that the remaining plan will become insolvent.

The new bankrupt companies' plan participant benefits are limited to the PBGC guarantee of up to $12,870 per year for a participant with 30 years of service and the PBGC loans money to the new plan to pay benefits and essential administration costs. The PBGC makes no interventions in the remaining plan.

To date, the PBGC has only partitioned three MDBPs: one in the 1980s, the Chicago Truck Drivers, Helpers and Warehouse Workers Union Pension Plan in 2010 and the Bakery and Sales Drivers Local 33 Industry Pension Fund in 2014. In 2014, the PBGC created a new plan with former Hostess participants. The average Hostess retiree's benefits were reduced from $650 per month to about $520 per month (PBGC, 2014).

1.3.5 MDBP Mergers

Two or more MDBPs may merge to create a new plan subject to the requirements of section 4321.3 of ERISA. The most important ERISA requirements are the following: no participant's or beneficiary's accrued benefit is lower after the effective date of the merger than immediately before the merger date and the new plan must pass a solvency test.

[14] The PBGC has booked the plan as a liability in the next 10 years.

1.3.6 MDBP Claims in Bankruptcy

When a contributing MDBP employer withdraws from a MDBP before or during bankruptcy, the MDBP withdrawal liability claim is a general unsecured claim in the bankruptcy court. In the event of a withdrawal from an MDBP postbankruptcy petition, some courts have granted administrative claim status to MDBP benefits earned between the petition date and the MDBP withdrawal date. In the event of the company's liquidation, 50% of the MDBP withdrawal liability claim is an unsecured general claim and the remaining 50% of the withdrawal liability claim is a subordinated debt, behind other debt claims but in front of equity claims.

1.3.7 MDBP Funding Status

The Pension Protection Act of 2006 (PPA 2006) plans mandates that MDBPs provide an annual plan status certifications based on standardized funding and liquidity measures for determining the financial health of plans. Actuaries calculate MDBPs' funded percentage by dividing the smoothed actuarial value of plan assets by plan liabilities discounted at the valuation rate. Plans are certified as either in critical, endangered or non-distressed status. Critical status is usually associated with funding ratios less than 65% whereas endangered status is associated with funding levels greater than 65% but less than 80%. Two-thirds of MDBPs were in critical or endangered status in the 2009 plan year (Department of Labor, Department of The Treasury and PBGC, 2013). PPA 2006 mandates that critical or endangered status MDBPs address under-funding through increased employer contributions and/or reductions in adjustable benefits.

Several factors have led to the serious underfunding of many MDBPs. MDBPs'

assets plummeted with the 2000 to 2002 market decline and the 2008 financial crisis. The decline of unionization across U.S. industry, obsolete and bankrupt MDBP employers and the decline in the percentage of active (current contributing employer) participants has eroded MDBPs' employer contribution base. Prior to PPA 2006, the U.S. tax code deterred plans from overfunding and protecting themselves from market and industry downturns since employer contributions were only tax-deductible when MDBPs were less than 100% funded. During the 1990s, more than 75% of MDBPs increased liabilities by raising benefits so that employers could receive current tax deductions on contractually required MDBP contributions (Department of Labor, Department of The Treasury and PBGC, 2013). Furthermore, increasing multiemployer healthcare costs diverted employer contributions from the longerterm requirement of funding pension plans. CBAs set MDBP employers contributions, usually for a 2- or 3-year period, making it difficult for MDBPs to quickly respond to funding deficiencies.

1.3.8 Companies' MDBP Disclosure Requirements

For fiscal years ending on or before December 15, 2011, public companies were only required to disclose their total contributions to MDBPs; however, some companies voluntarily disclosed more detailed information. For example, Kroger discloses their best estimate of their aggregate MDBP withdrawal liability in their 10-Ks and Arkansas Best Freight and YRC Worldwide disclose that they are major contributors to the Central States in their 10-Ks.

In September 2011, the Federal Accounting Standards Board (FASB) issued Accounting Standards Updates 2011-09, "Disclosures about an Employer's Participation

in a Multiemployer Plan." The new disclosures include employer contributions made to each significant plan and to all plans in the aggregate, an indication of whether the employer's contributions represent more than 5% of total contributions to the plan, an indication of which plans are subject to a funding improvement plan, the expiration date(s) of the CBA(s) and any minimum funding arrangements, the most recent certified funded status of the plan, and a description of the nature and effect of any changes affecting comparability for each period in which a statement of income is presented. The funded status of the plan allows investors to estimate the MDBPs' degree of underfunding. However, in order to estimate a company's MDBP liability, investors require the 10-K employer contribution information together with Form 5500 information. The new MDBP disclosures were effective for public company for fiscal years ending after December 15, 2011, with early adoption permitted. Private companies were required to adopt the new MDBP disclosures for fiscal years ending after December 15, 2012.

1.4 Data Collection

MDBPs must file Form 5500 to satisfy ERISA and IRS annual reporting requirements. Form 5500 contains information on MDBP assets, liabilities, and major employer contributions. From the 2009 plan year onwards, investors can estimate MDBP liabilities of major contributing companies using Form 5500 information; however, it is necessary to link subsidiaries to their parents in order to obtain good estimates of a public company's total MDBP liabilities. For fiscal years ending after December 15, 2011, investors can use 10-K information together with Form 5500 information to estimate public companies' MDBP liabilities. I download the 2009 Form 5500 (All) data from the DOL

website (http://www.dol.gov/ebsa/foia/foia-5500.html). I merge the 2009 Form 5500 (All) data with the 2009 Form 5500 schedule H, schedule MB and schedule R data using the MDBP filing's unique key. The original dataset contains information on MDBPs, SDBPs, multiemployer plans and direct filing entities therefore I select MDBPs with filing status not equal to 'processing_stopped'.[15] In order to assemble data on MDBP contributing employers, I select MDBPs with Schedule R attached. The 2009 MDBP datasets contain some filings from previous years so I select plans where the MDBP valuation year is 2009, if the MDBP valuation date is missing, I include the MDBP if the year of the MDBP's form begin date is 2009. I delete observations for which either Form 5500 Schedule R's RPA94 liability is missing or Form 5500 Schedule H's end of year net plan assets are missing. MDBPs are uniquely identified by their employer identification number and their plan number but may have multiple filings; where there are multiple filings for the same plan, I select the plan filing with the earliest filing date and contributing employer Schedule R information.

I collect data for both public parent companies and their subsidiaries. Form 5500 schedule R lists both the contributing employer's name and the contributing employer's employer identification number (EIN). I wish to match Schedule R subsidiaries to their public parent companies. However, as Rauh, Stefanescu, and Zeldes (2013) explain, a subsidiary's EIN often differs from its parent's Compustat EIN:

> Under the current IRS rules, subsidiaries that are at least 80% owned by the parent may elect to file consolidated income tax returns. But they can also choose to file taxes separately while still remaining consolidated with the parent company for financial purposes. In this case, the EIN and the sponsor name reported in Form 5500 will differ from its parent's. (p. 12)

[15] EFAST2 Program Management Office personnel informed me that the public could view 'filing_error' plan filings but not 'processing_stopped' plan filings.

In order to match Schedule R companies to their public parents, I first follow Rauh et al. (2013) and match the Schedule R company's EIN to their public parent's EIN. For companies that cannot be matched using their EIN, I search Hoover's database for potential public parents using the Schedule R company name. Companies may use the same name so I use the industry and the MDBP location to identify the correct Hoover's company.

When Hoover's lists a potential public parent for the Schedule R company, I search Exhibit 21 (listing of active subsidiaries) of the most recent public parent's 10-K available before the Form 5500 filing date, for the Schedule R company name. If the company is not listed on Exhibit 21, I search the rest of the public company's 10-K for mention of the Schedule R listed company. Public companies need only list in Exhibit 21 their "significant" subsidiaries who contribute more than 10% of consolidated assets or pretax income at the end of the last fiscal year (Lignon & Malm, 2013). Therefore, if a Schedule R company is not listed in Exhibit 21 or mentioned in the 10-K, I ascertain whether the Schedule R company's website discloses that it is a subsidiary of the parent public company.[16] If I still cannot verify the Hoover's Schedule R company match to its public parent, I search the internet to see whether the employer EIN is associated with a public company's pension plans. I also use einfinder.com to match Schedule R company's EINs with a public company. I also search the internet for court documents or news stories that may link the Form 5500 company to its public parent.

I require that a Form 5500 company can be matched to a public company parent in at least two ways to enter my sample. I require that a MDBP has at least one U.S. incorporated public firm listed on the NYSE, NASDAQ or AMEX exchanges on the plan's

[16] EMCOR's subsidiaries all disclose on their websites that they are EMCOR's subsidiaries.

filing to enter my sample. I delete companies making a withdrawal liability payment to the MDBP because these companies no longer belong to the MDBP and are not exposed to MDBP liability spillovers. When an individual MDBP has two or more observations for the same public company, I add together the pension contributions amounts and consolidate the public employer information into one MDBP public company observation.

In order to analyze expected MDBP liability spillovers inter- and intraindustry, I assign public companies to 10 broad industry groups: transportation, food/retail, entertainment/printing, construction/engineering/steel, mines/coal/oil, hotels/casinos, aircraft, waste management, paper/paperboard, and other. My industry groupings are inspired by Moody's (2009) industry groupings and frequently observed additional industries seen in the data. In contrast to Moody's, I include a waste management industry group since I observed several MDBPs where the contributing Schedule R employers belonged to the waste management industry.

I collect public company's total MDBP employer contributions from the public company's 10-K. In my sample, 2009 plan year MDBP year ends vary from December 31, 2009, until November 30, 2010, with the majority (56%) of MDBP plan years ending on December 31, 2009, and 88% ending on or before June 30, 2010. Public companies may belong to several MDBPs; it is therefore difficult to obtain an exact date match between a company's reported 10-K total MDBP employer contributions and the public company's total Schedule R contributions. I therefore use the following methodology to collect public company total employer MDBP contributions. If the company's fiscal year ends on or before June 30, 2010, I use the most recent reported fiscal year total employer MDBP contributions. If the company's fiscal year ends after June 30, 2010, I use the average of

the 2009 and 2010 fiscal year total MDBP contributions. If a company does not report its 2009 fiscal year total MDBP contributions, I use the 2010 fiscal year total MDBP contributions.

In order to summarize MDBP liability spillover information available to market participants, I calculate expected MDBP liability spillovers from publicly available Form 5500 filings on a monthly basis from July 30, 2010 to November 30, 2011. I choose an initial date of July 30, 2010 because the date of the first 2009 plan year MDBP Form 5500 filing with at least two public companies is July 28, 2010. I chose a final date of the November 30, 2010, because for fiscal years ending after December 15, 2011, public companies must disclose their significant MDBPs. Therefore, after December 15, 2011, both public company 10-Ks and MDBP Form 5500 filings contain information about expected MDBP liability spillovers.

I calculate expected MDBP liability spillovers on a rolling monthly basis. If a MDBP filed its 2010 plan year information before the month's end date, I replace the MDBP's 2009 plan year information with its 2010 plan year information. I also add information from 2010 plan year MDBP filings for plans that are not included in my 2009 plan year data set but list at least one of the EINS associated with my 2009 plan year public companies in their 2010 plan year Schedule R. In order to calculate bankruptcy probabilities, I follow I calculate Altman (1968) Z-scores from Compustat data with company fiscal year ends at least 4 months before the MDBP public release date to ensure data availability to market participants.

1.4.1 Calculating a Company's Share of Unfunded MDBP Liabilities

Generally for MDBP plan years beginning after 2007, the statutory interest rate used to discount current pension liability must be between 90% and 105% of the weighted average of the rates of interest on 30-year Treasury securities during the 4-year period ending on the last day before the beginning of the plan year. The present value of pension benefits accrued to date discounted at the statutory interest rate is called the RPA 94 current liability. Moody's (2006) uses the RPA 94 current liability because it is a standard liability measure across companies whereas actuarial liabilities can vary across companies both in the actual discount rate used and the methodology. Moody's use RPA 94 current liability multiplied by 90% less current assets and multiplied by 50% to estimate a MDBP's unfunded liability. I follow Moody's (2006) methodology to estimate a MDBP's unfunded liability; specifically, I subtract Form 5500 Schedule H's end of year net plan assets from 90% of Form 5500's Schedule MB RPA 94 liability and then multiply by 50%.[17]

Actuaries calculate MDBP withdrawal liabilities using a company's share of the unfunded MDBP liabilities. Therefore, it is reasonable to first estimate a plan's unfunded liabilities (liabilities minus assets) to estimate a company's ongoing MDBP liability. Although the RPA 94 current liability has the advantage that it is a standard measure across companies, it uses Treasury bond interest rates to discount pension liabilities making the RPA 94 liabilities larger than liabilities discounted using corporate bond interest rates. MDBPs may invest in corporate bonds as well as treasury bonds to match their liabilities; therefore, reducing the RPA94 liability by multiplying by 90% better reflects a MDBP's

[17] Moody's (2006) expects that union employees will share 50% of the MDBP underfunding burden through giving up current wages and other benefits in exchange for increased MDBP funding while companies will fund the remaining 50% of the MDBP underfunding.

liabilities. Moody's halved the MDBP unfunded liability (RPA 94 liability minus plan assets) to account for further pension benefit reductions and wage concessions from labor after feedback from MDBP actuaries and other MDBP stakeholders. In my calculations, I estimate a company's ongoing MDBP liabilities rather than its withdrawal liability and follow Moody's methodology by halving the MDBP unfunded liability to account for concessions from labor providing the best estimate of a MDBP's ongoing unfunded liability. I illustrate below how I calculate an individual MDBP's unfunded liabilities denoted as UL_{MDBP}:

$$UL_{MDBP}=0.9 \times (L-A) \times 0.5 \quad (1.1)$$

where L=RPA 94 Liability and A= Current Value of Net Assets

I give a numerical example illustrating the calculation of a MDBP's unfunded liability in Appendix A.1.

I follow the methodology of Zion et al. (2012) and estimate an employer's share of the MDBP unfunded liabilities by using the Form 5500 Schedule R's employer's plan year contributions divided by the total employer plan year contributions. Company withdrawal liabilities can be calculated using either the unfunded vested benefits traceable to the company's employees or allocating a company's share of the MDBP's unfunded liability using the company's share of total plan contributions over a specified period (McMurdy, 2009). Data on a company's traceable unfunded vested benefits are not available, and employer contributions data only became available from the 2009 plan year onwards. Therefore, given the data limitations, using the 2009 plan year employer contributions as a percentage of total employer contributions to allocate employer MDBP unfunded liabilities

is a reasonable methodology to employ. I use the schedule MB total employer contributions for the total employer contributions. I use schedule H total contributions for the total employer contributions when schedule MB total employer contributions are missing. When the plan's total Schedule R employer contributions are greater than the total employer contributions, I use the schedule R total employer contributions to calculate the employer's share of the MDBP liabilities. Otherwise I use the total employer contributions. For the 2009 plan year, 12 out of 333 plans have schedule R total employer contributions greater than Schedule MB total employer contributions.

I calculate a schedule R company A's share of the MDBP unfunded liabilities denoted as UL_A as follows:

$$UL_A = C_A/TC \times UL_{MDBP} \quad (1.2)$$

where C_A =Company A's Contributions and TC=Total Employer Contributions

I give a numerical example showing the calculation of a company's share of a MDBP's unfunded liability in Appendix A.2.

YRC Worldwide (YRC hereafter) temporarily suspended their contributions to a majority of their MDBPs beginning in the second half of 2009 and continuing throughout 2010. In order to calculate YRC's MDBP liabilities, I assume that YRC's recorded 2009 Schedule R contributions represent 50% of YRC's unsuspended annual contributions. Therefore, I double YRC's Schedule R pension contributions for the 2009 plan year and I adjust the plan's total employer contributions accordingly. I do not replace 2009 plan year MDBP information listing YRC or its subsidiaries on Schedule R with the 2010 plan year MDBP information. YRC contributed in aggregate $554.1 million to 20 multiemployer pension plans in fiscal year 2008, and in 2009, Central States represented 58% of the

company's monthly pension funding obligations (Fleet Owner, 2009). Therefore, a reasonable estimate of YRC's 2009 plan year unsuspended contribution to the Central States is $321 million (58% of $554.1 million). After doubling YRC's 2009 Schedule R contributions, I estimate that YRC makes a $276 million contribution to Central States; my estimate is similar in magnitude to the $321 million estimate from other sources. YRC's contributions to Central States is 94% of its total 2009 Schedule R contributions. Therefore, doubling YRC's 2009 Schedule R contribution in order to estimate YRC's MDBP liabilities is a reasonable adjustment to account for YRC's suspension of contributions to MDBPs in the second half of 2009.

1.4.2 Calculation of LMS MDBP Liability Spillovers

I define a firm's LMS liability spillovers as the total liability spillovers from other Schedule R firms in the event that all other Schedule R firms file for bankruptcy. LMS MDBP liability spillovers are an extreme case and represent the maximum MDBP liability spillover onto a nonbankrupt company by other bankrupt Schedule R firms. I calculate a firm's LMS liability spillovers from both public and private firms. In order to calculate LMS MDBP liability spillover, I make two assumptions: In the event of bankruptcy, a company withdraws from a MDBP and the MDBP recovers none of its unsecured withdrawal liability claim and nonbankrupt MDBP companies inherit bankrupt companies' MDBP liabilities in proportion to their share of total nonbankrupt company MDBP contributions. I calculate LMS MDBP liability spillover in two stages: First I calculate a nonbankrupt firm A's share of the bankrupt firm(s) MDBP liability denoted by S_A by dividing the nonbankrupt firm's MDBP contribution by nonbankrupt firms' total MDBP

contributions and second I calculate the MDBP spillover onto the nonbankrupt company A denoted by $SLMS_{A,-A}$ by multiplying the nonbankrupt company's share of the total MDBP spillover (i) by the bankrupt firm(s) MDBP liability.

1.4.2.1 *Calculating LMS MDBP Liability Spillovers With Two Public Schedule R Companies*

I calculate LMS MDBP liability spillovers with two public Schedule R companies as follows:

$$S_A = C_A / (TC - C_B) \qquad SLMS_{A,-A} = S_A \times UL_B \quad . \tag{1.3}$$

where S_A is company A's share of bankrupt company B's MDBP liabilities

where $SLMS_{A,-A}$ is the spillover of bankrupt company B's MDBP liabilities onto company A

I give a numerical example illustrating how I calculate LMS MDBP liability spillovers with two Public Schedule R Companies in Appendix A.3.

1.4.2.2 *Calculating LMS MDBP Liability Spillovers With Three Public Schedule R Companies*

I calculate LMS MDBP liability spillovers with three public Schedule R companies as follows:

$$S_A = C_A / (TC - C_B - C_C)$$

$$SLMS_{A,-A} = S_A \times (UL_B + UL_C) \tag{1.4}$$

I give a numerical example illustrating how I calculate LMS MDBP liability

spillovers with three public Schedule R companies in Appendix A.4.

1.4.3 Calculation of Bankruptcy Probabilities

In order to calculate a company's 1-year expected MDBP liability spillovers, I first estimate each public company's bankruptcy probabilities denoted as p_i. The Form 5500 Schedule R companies are mostly subsidiaries of public parent companies; Kolasinski (2009) explains that a strong subisidary is generally rated no higher than its parent[18] and industrial firms mostly file for bankruptcy with their subsidiaries. Therefore, for the majority of MDBP firms, the parent public bankruptcy probability is most likely a lower bound on the subsidiary's bankruptcy probability.

I use Altman (1968) Z-scores to estimate bankruptcy probabilities. I chose to use Z-scores rather than Ohlson (1980) O-scores or probabilities based on the Black and Scholes (1973) and Merton (1974) option-pricing model because Z-scores have the smallest number of missing values and my aim is to provide a comprehensive quantification of public companies expected MDBP liability spillovers. When a company files for bankruptcy, I set its bankruptcy probability to one. I follow Mansi, Maxwell, and Zhang (2013) and reverse the signs of the original Altman's Z-score coefficients so that the Z-score is increasing in bankruptcy probability. I follow Mansi et al. (2013) and calculate negative Altman Z-scores using the following model:

$$\text{Negative Altman Z-score} = -1.2*wcta - 1.4*reta - 3.3*ebitta - 0.60*mvliab - 0.999sata \quad (1.5)$$

[18] Kolasinski gives two key reasons why subsidiaries are rated no higher than their parent: (1) a weak financially distressed parent's ability and incentive to take assets from and burden its subsidiaries with debt and (2) the likelihood that a parent's bankruptcy would cause a strong standalone subsidiary's bankruptcy.

where *wcta* is working capital (current assets – current liabilities) scaled by total assets, *reta* is retained earnings scaled by total assets, *mvliab* is market value of equity divided by total liability, and *sata* is sales divided by total assets.

I follow Hillgeist, Keating, and Lundstedt (2004) and convert the negative Altman Z-scores to probabilities using

$$p_i = \frac{e_i^{Score}}{1 + e_i^{Score}} \tag{1.6}$$

Hillgeist et al. (2004) point out that although this transformation is not strictly correct for the Multiple Discriminant Analysis (MDA) estimated Z-score, McFadden (1976) shows that under normality assumptions the MDA and logit approaches are closely related.

1.4.4. Calculation of 1-year Expected Public Company MDBP Liability Spillovers

In order to calculate 1-year expected MDBP liability spillovers, I make the same four assumptions as I do in the LMS case. I calculate 1-year expected MDBP liability spillovers in two stages:

1. I calculate the LMS MDBP liability spillover onto the nonbankrupt company denoted by $SLMS_{A,-A}$.
2. I calculate the expected MDBP spillover onto the nonbankrupt firm denoted by $SEXP_{A,-A}$ by multiplying the bankruptcy event probability by $SLMS_{A,-A.}$

1.4.4.1 *Calculating One-year Expected MDBP Liability Spillovers With Two Public Schedule R Companies*

$$SEXP_{A,-A} = SLMS_{A,-A} \times p_B \times (1-p_A) \quad (1.7)$$

where $SEXP_{A,-A}$ is the expected MDBP liability spillover of bankrupt company B onto company A and where p_A is the probability that company A goes bankrupt in the next year.

1.4.4.2 *Calculating 1-year Expected MDBP Liability Spillovers With Three Public Schedule R Companies*

$$SEXP_{A,B} = SLMS_{A,B} \times p_B \times (1-p_C) \times (1-p_{A,})$$

$$SEXP_{A,C} = SLMS_{A,C} \times p_C \times (1-p_B) \times (1-p_A)$$

$$SEXP_{A,BC} = SLMS_{A,B} \times p_B \times p_C \times (1-p_A)$$

$$SEXP_{A,-A} = SEXP_{A,B} + SLMS_{A,C} + SEXP_{A,BC} \quad (1.8)$$

where $SEXP_{A,B}$ is the expected MDBP liability spillover onto A when only B goes bankrupt, $SEXP_{A,C}$ is the expected MDBP liability spillover onto A when only C goes bankrupt, and $SEXP_{A,BC}$ is the expected MDBP liability spillover onto A when both B and C go bankrupt.

1.4.5 Calculation of 5-Year Expected MDBP Public Company MDBP Liability Spillovers

In order to calculate 5-year expected MDBP liability spillovers, I further assume that 1-year bankruptcy probabilities remain constant over a 5-year period and assume a 5% discount rate. I calculate 5-year spillovers for plans with two or three public companies. I

calculate expected 5-year MDBP liability spillovers onto the nonbankrupt company in two stages:

1. I calculate the LMS MDBP liability spillover onto the nonbankrupt company denoted by $SLMS_{A,-A}$.
2. I calculate the 5-year expected MDBP spillover onto the nonbankrupt firm denoted by $S5EXP_{A,-A}$ by multiplying the 5-year bankruptcy event probability by $SLMS_{A,A}$.

In the two public company case, there are five possible spillover events where company B's MDBP liability spills onto company A. I illustrate the five possible events in Table 1.1.

I show how I calculate spillover probabilities, discounted MDBP liability spillovers, and discounted expected MDBP liability spillovers in Table 1.2. I sum up five expected discounted MDBP liability spillovers to calculate the total 5-year expected MDBP liability spillover from company B onto company A. In the three Schedule R public company case, there are 35 possible spillover events where company B's MDBP liability and/or company C's MDBP liability spills onto company A. I illustrate the 35 possible spillover events in Table 1.3. In Figure 1.1, I show how I calculate spillover event probabilities, discounted MDBP liability spillovers, and discounted MDBP liability spillovers for the three Schedule R public company MDBP case using a numeric example.

1.5 Calculation of Leverage Ratios

I examine the effect of MDBP liabilities and expected 1-year MDBP liability spillovers on MDBP public companies' leverage ratios. I calculate MDBP liabilities and the sum of MDBP liabilities and expected 1-year MDBP liability spillovers as a percentage

of long-term debt. I follow the methodology of Shivdasani and Stefanescu (2010) to calculate three measures of leverage from the reported balance sheet. I also report these three leverage measures with debt consolidated with MDBP liabilities and with debt consolidated with the sum of MDBP liabilities and expected MDBP liability spillovers. I calculate *Book D/A* as the ratio of long-term debt plus the current portion of long-term debt to the book value of assets, *Book D/D+E* as the ratio of book long-term debt to the book value of equity plus the book value of long-term debt and *Market D/A* as the ratio of the book value of long-term debt to the market value of assets (book value of assets minus book value of equity plus the market value of equity).

1.6 Sample Selection

For the 2009 plan year, there are 4,902 first filing observations associated with 1,366 unique MDBPs. I delete 10 observations from the Pennsylvania Heavy and Highway Contractors Pension Trust because there are three observations for each of the five Schedule R employers with the same total employer contribution but different contributions rates.[19] I delete one observation because the public company's MDBP contribution is a withdrawal payment.

There are 1,389 observations, 333 unique MDBPs and 529 public company observations for MDBPs with at least one U.S. incorporated public company listed on Schedule R. In Table 1.4, I detail how I matched Schedule R companies to public companies.

I lose 40 observations because I consolidate all public company observations in the

[19] I check data integrity by downloading the original Form 5500's pdf from https://www.efast.dol.gov/portal/app/disseminate?execution=e1s1.

same MDBP into one public company MDBP observation. My final 2009 plan year sample consists of 1,349 observations, 333 unique MDBPs and 489 public company observations associated with 154 unique public companies with 144 U.S. incorporated public companies. In order to summarize 2009 plan year expected liability spillovers, I use 2010 fiscal year Z-scores and Z probabilities.

In order to examine expected spillover information disclosed to the market through Form 5500 filings through time, I calculate expected liability spillovers available from public Form 5500 information on a monthly basis. I have 17 month end-dates starting at July 30, 2010, and ending on November 30, 2011. I use the most recent publicly available Form 5500 information. Consequently, I replace 189 2009 plan year MDBPs with their corresponding 2010 plan year MDBP. Twenty-three MDBPs no longer list any 2009 plan year public companies on their 2010 plan year Schedule R. I include 25 new 2010 plan year MDBPs which contain at least one Schedule R employer EIN associated with my 2009 plan year public companies where the 2009 plan year public company was not previously listed on the MDBP's 2009 plan year Schedule R.

1.7 Sample Description

1.7.1 Plan Characteristics

For the 2009 plan year, MDBP first filing dates range from June 4, 2010, to September 15, 2011, 54.1% of filing dates are between October 5, 2010, and October 22, 2010.[20] MDBP unfunded liabilities for 2009 plan year range from -$331.5 million to $12.1 billion with a mean of $ 190.2 million and a median of $29.1 million. The distribution of

[20] MDBP plans must file 7 months after the plan year end and may apply for a 2.5 month filing date extension. Most plan years end on December 31, MDBP filing dates cluster around mid-October 2010.

plan unfunded liabilities is severely positively skewed (skew=11.1). Two plans have unfunded liabilities larger than $7 billion,[21] whereas 63.7% of plans have unfunded liabilities of less than $50 million. In Figure 1.2, I plot a histogram of the distribution of plan unfunded liabilities.

For an individual MDBP, the number of Schedule R companies ranges from 1 to 18 with a mean and median of four companies. Schedule R does not list companies contributing 5% or less of the total plan year contributions. I detail the distribution of the number of Schedule R public companies for an individual MDBP in Table 1.5. For an individual MDBP, the number of Schedule R public companies ranges from 1 to 6 with a mean of 1.5 companies (median 1.0 company) whereas the number of Schedule R private companies ranges from one to 16 with a mean of 2.8 companies (median 2.0 companies).

1.7.2 Public Company Characteristics

In my final sample, there are 154 unique public MDBP companies, 144 of whom are incorporated in the U.S. The 154 public companies appear on between 1 and 35 MDBP Schedule Rs with a mean of 3.2 Schedule Rs and a median of one Schedule R. Table 1.6 shows the distribution of the number of public companies appearing on MDBP Schedule Rs.

In Table 1.7, I compare public MDBP company fiscal year 2010 summary statistics with those of Compustat companies listed on the NYSE, NASDAQ, or AMEX exchanges.

On average, public MDBP companies are more than three times larger and have a

[21] The Central States, Southeast and Southwest Areas Pension Plan (Central States) has $12.1 billion in unfunded liabilities and the Western Conference of Teamsters Pension Plan has $7.0 billion in unfunded liabilities.

lower market to book ratio than Compustat public companies. For fiscal year 2010, public MDBP companies have a mean market value of equity of $15.6 billion (median $3.6 billion) with a mean market to book ratio of 3.7 (median 1.8) whereas public Compustat companies have a mean market value of equity of $5.0 billion (median $0.6 billion) with a mean market to book ratio of 5.7 (median 1.7). MDBP companies' median Z-probability is 7% whereas public Compustat companies' median Z-probability is 4%. In 2011, 88 public equity or public debt companies filed for bankruptcy compared to 106 public companies in 2010 and 211 public companies in 2009 (Hamiton 2012). In 2011, there were 9,291 public equity or public debt companies with a 0.95% bankruptcy rate.

1.7.3 Company Individual MDBP Liabilities

Company individual MDBP liabilities may be negative when a plan's net assets exceed the plan's liabilities. Company individual MDBP liabilities range from -$44.9 million to $4.4 billion (YRC Worldwide's share of the Central State's unfunded liability) and are extremely skewed, the mean MDBP Schedule R company liability is $23.9 million with a median of $2.6 million. In Figure 1.3, I plot a histogram of individual MDBP company liabilities. Schedule R employer contributions cover on average 61.9% (median 63.9%) of total MDBP employer contributions. Public company schedule R contributions cover on average 29.9% (median 19.9%) of the total MDBP employer contributions and private company schedule R contributions cover on average 32.0% (median 30.5%) of total MDBP employer contributions.

1.7.4 Public Company Total MDBP Liabilities for the 2009 Plan Year

I sum public company MDBP liabilities across plans. The total 2009 plan year MDBP public company liability ranges from -$30.4 million to $6.2 billion (United Parcel Service Inc.), with a mean total public company liability of $155.3 million (median of $10.2 million). The distribution of public company total MDBP liabilities is severely positively skewed (skew=7.0). Six companies have total MDBP liabilities of more than $1 billion whereas 76 companies have total MDBP liabilities of less than $10 million. Using 2010 fiscal year[22] COMPUSTAT market values and total assets, I find that the mean total public company MDBP unfunded liability as a percentage of book assets is 3.5% (median 0.2%) whereas the mean total public unfunded SDBP liability as a percentage of book assets is 2.8% (median 1.2%).[23] The mean total public company MDBP liability as a percentage of market value of equity is 37.1% [24](median 0.3%). For the 2009 plan year, the aggregate public company MDBP unfunded liability was $23.9 billion while the aggregate public company SDBP unfunded liability of 1,366 companies was $454.6 billion. In Table 1.8, I present summary statistics for total public company MDBP liabilities by broad industry group. Transportation industry companies account for over one half (51.8%) of these aggregate liabilities, three companies account for 96% of aggregate transportation MDBP liabilities: UPS with $6.2 billion, YRC Worldwide with $4.6 billion, and Arkansas Best with $1.1 billion. Food/Retail companies account for 29.0% of aggregate MDBP liabilities;

[22] I use 2010 fiscal year total assets and market value of equity because 2009 plan years end from December 31, 2009, until November 30, 2010 and 2009 plans file from June 2010 until September 2011.
[23] I define public company as a company that has shares traded on the NYSE, AMEX or NASDAQ exchanges. Using Compustat data, I follow Stefanescu and Shivdasani (2010) and calculate SDBP unfunded liability as (pbpro +pbpru)-(pplao+pplau).
[24] Three companies have MDBP liabilities bigger than their market value of equity: YRC Worldwide (2,591%), Great Atlantic and Pacific Tea Company (2,361%) and Arkansas Best (165%) leading to a large mean for MDBP liabilities as a percentage of market equity.

three companies account for 83% of aggregate food/retail liabilities: Safeway with $2.6 billion, Kroger with $2.0 billion, and Supervalu with $1.2 billion. The four mines/coal/oil companies account for 5.6% of aggregate liabilities; all four companies have MDBP liabilities greater than 3% of their market value of equity.

In Table 1.9, I list the 22 public companies with unfunded MDBP liabilities exceeding $120 million together with the company's MDBP liability characteristics. MDBP liabilities are significant in terms of book assets in 28% of MDBP public companies. Forty-four companies have total public company MDBP liabilities exceeding 1% of their book assets; for these 44 companies, the median total public company MDBP liability as a percentage of book assets is 3.3% and the median total public company MDBP liability as a percentage of market equity is 4.9%.

Sixteen companies have total public company MDBP liabilities bigger than 5% of their book assets; for these 16 companies, the median total public company MDBP liability as a percentage of book assets is 9.6% and the median total public company MDBP liability as a percentage of market value of equity is 14.7%.

Eight companies have total public company MDBP liabilities bigger than 10% of their book assets; for these eight companies, the median total public company MDBP liability as a percentage of book assets is 16.5% and the median total public company MDBP liability as a percentage of market value of equity is 23.0%. Three companies have MDBP liabilities bigger than their market value of equity: YRC Worldwide (2,591%), Great Atlantic and Pacific Tea Company (2,361%), [25]and Arkansas Best (165%). Seventy of the 144 U.S. incorporated companies disclose in their 10-Ks their total MDBP

[25] Great Atlantic and Pacific Tea Company was a distressed company; its market value of equity at the end of fiscal year 2010 was $13.5 million.

contributions with a mean total contribution of $56.4 million (median $15.2 million); on average, total Schedule R contributions account for 74.3%[26] (median 60.6%) of these 70 companies total annual MDBP contributions. In Table 1.10, I present leverage ratios for nonfinancial and nonutility MDBP companies and Compustat companies with no missing leverage information and positive book equity. MDBP public companies are more levered then Compustat companies; MDBP public companies' mean leverage ratios are about 40% higher than those of Compustat companies. For MDBP companies, Book D/A increases from a mean of 0.84 (median 0.83) to 0.87 (median 0.84) once unfunded MDBP liabilities are consolidated, Market D/A increases from a mean of 0.46 (median 0.46) to 0.48 (median 0.47) once unfunded MDBP liabilities are consolidated and Book D/ (D+E) increases from a mean of 0.61 (median 0.59) to 0.63 (median 0.60) once unfunded MDBP liabilities are consolidated. In sum, leverage ratios rise on average by about 4% once unfunded MDBP liabilities are consolidated.

1.7.5 Public Companies' LMS MDBP Liability Spillovers for the 2009 Plan Year

Public companies must belong to at least one MDBP with two or more Schedule R companies in order to be exposed to LMS liability spillovers; in my sample, 151 public companies are exposed to LMS MDBP liability spillovers; the mean number of MDBPs exposing these 151 companies to LMS MDBP liability spillover risks is 3.0 plans (median one plan). There are 304 MDBPs exposing public companies to LMS liability spillovers

[26] Eleven companies' total 2009 plan year Schedule R contributions are bigger than their 10-K total MDBP contributions, for the remaining 59 companies the mean total Schedule R contributions account for 48.5% (median 48.6%) of their total annual MDBP contributions.

from both private and public companies. LMS liability spillovers from both private and public companies range from -$37.2 million to $2.65 billion (Safeway) with a mean of $88.4 million (median $6.4 million). LMS MDBP liability spillover is severely skewed (skew=6.1). Eighteen companies have LMS MDBP liability spillovers larger than $100 million and 37 companies have LMS MDBP liability spillovers smaller than $1 million.

LMS MDBP liability spillovers as a percentage of book assets range from -0.2% to 92.6% (Arkansas Best) with a mean of 2.1% (median 0.2%). LMS MDBP liability spillover as a percentage of book assets is severely skewed (skew=9.0). Eight companies have LMS MDBP liability spillovers larger than 10% of their book assets and 76 companies have LMS MDBP liability spillovers smaller than 0.1% of their book assets. Ten companies have LMS MDBP liability spillovers larger than 10% of their market value of equity and 63 companies have LMS MDBP liability spillovers smaller than 0.1% of their market value of equity.

I split the LMS MDBP liability spillovers into liability spillovers from public and private companies. For the 87 companies that have both positive public and private LMS MDBP liability spillovers, on average, MDBP LMS liabilities from other public companies account for 35.1% (median 29.3%) of public and private LMS MDBP liabilities.

For the 103 public companies with LMS MDBP liability spillovers from other public firms, the mean LMS MDBP liability spillover from other public firms is $63.6 million (median $3.0 million). Public LMS MDBP liability spillover is skewed (skew=4.3). Twelve companies have LMS public MDBP liability spillovers larger than $100 million and 33 companies have LMS public MDBP liability spillovers smaller than $1 million. LMS public MDBP liability spillover as a percentage of book assets has a mean

of 1.8% (median 0.0%). LMS public MDBP liability spillover as a percentage of book assets is severely skewed (skew=8.9). Three companies have LMS public MDBP liability spillovers as a percentage of book assets larger than 10% and 66 companies have LMS public MDBP liability spillovers as a percentage of book assets smaller than 0.1%.

One-hundred-and-thirty-nine public companies have LMS MDBP liability spillovers from private companies with a mean private LMS MDBP liability spillover of $48.9 million (median $5.0 million). Private LMS MDBP liability spillover is skewed (skew=6.4). Eleven companies have LMS private MDBP liability spillovers larger than $100 million and 31 companies have LMS private MDBP liability spillovers smaller than $1 million. LMS private MDBP liability spillover as a percentage of book assets has a mean of 1% (median 0.1%). LMS private MDBP liability spillover as a percentage of book assets is skewed (skew=3.5). Three companies have private LMS MDBP liability spillovers as a percentage of market equity larger than 10% and 75 companies have LMS MDBP liability spillovers as a percentage of market equity smaller than 0.1%.

1.7.6 Public Companies' Expected MDBP Liability Spillovers for the 2009 Plan Year

Public companies must belong to at least one MDBP with two or more Schedule R public companies in order to be exposed to expected public company liability spillovers; in my sample, 103 public companies are exposed to expected MDBP public company spillovers; of these 103 companies, the mean number of MDBPs exposing them to public company liability spillover risks is 2.6 plans (median one plan). In Table 1.11, I present the distribution of the number of MDBPS exposing public companies to MDBP liability

spillovers from other public companies. In order to calculate expected public company liability spillover risks for an individual plan, all public companies in the plan must have nonmissing Z-scores. I use 2010 fiscal year Z-scores to calculate 2009 plan year expected MDBP liability spillovers. I present a histogram of my sample's negative Altman Z-scores in Figure 1.4.

There are 115 MDBPs exposing public companies to liability spillovers from other public companies; 19 of these MDBPs have missing expected MDBP liability spillovers due to missing Z-scores. For the 2009 plan year, 28 of the 103 liability spillover risk exposed companies have at least one MDBP where the public company liability spillover risk is missing due to at least one missing Z-score. For the remaining 75 companies, the 1-year expected MDBP liability spillover ranges from \$0.0 million to \$194.5 million (Arkansas Best[27]), with a mean of \$5.3 million (median \$0.3 million). One-year expected MDBP liability spillover is severely skewed (skew=7.8). Thirteen companies have 1-year expected liability spillovers of more than \$5 million and 51 companies have 1-year expected MDBP liability spillovers of less than \$0.1 million. For the 23 companies whose expected 1-year MDBP liability spillovers exceed \$1 million, the mean expected MDBP liability spillover is \$17.6 million (median \$8.2 million). The mean expected MDBP liability spillovers as a percentage of total assets is 1.2% (median 0.1%) and the mean expected MDBP liability spillovers as a percentage of market value of equity is 4.6% (median 0.2%). In Table 1.12, I tabulate the 23 companies with 1-year expected MDBP liability spillovers greater than \$1 million.

For the 75 companies with no missing Z-scores, the mean LMS MDBP liability

[27] \$179.3 million of Arkansas Best's expected liability spillover is from YRC Worldwide in the Central States Pension Plan.

spillover is 22.5 times greater than the mean 1-year expected MDBP liability spillover. The mean LMS MDBP liability spillover as a percentage of book assets is 9.6 times greater than the mean 1-year expected MDBP liability spillover as a percentage of book assets. I compare LMS MDBP liabilities with 1-year expected MDBP liabilities in Table 1.13. The LMS MDBP liability spillover is a worst-case scenario because it assumes that all other public and private Schedule R companies go bankrupt. In contrast, the 1-year expected MDBP liability spillover only considers liability spillovers from public MDBP companies and assumes that public Schedule R companies' bankruptcy probabilities are independent. MDBP company bankruptcy probabilities are most likely correlated because most often MDBP sharing companies are in the same industry. Therefore, the actual 1-year expected MDBP liability spillover lies somewhere between my calculated expected 1-year MDBP liability spillover and my calculated LMS liability spillover. I calculate 5-year expected MDBP liability spillovers for plans with two or three public companies using a 5% discount rate. Two-hundred-and-nine of the 218 nonmissing MDBP expected liability spillovers observations are associated with plans with two or three public companies. On average, a company's 5-year expected MDBP liability spillovers is 2.6 times its 1-year expected MDBP liability spillovers. There are 66 firms with no missing expected MDBP liability spillovers and belonging only to plans with less than four public companies. For these 66 companies, the mean 5-year expected MDBP liability spillover is $10.1 million, 2.4 times the mean 1-year expected MDBP liability spillovers, bigger than 0.1% of their book assets

For the 75 companies with no missing expected MDBP liability spillovers, 1-year expected MDBP liability spillovers as a percentage of total assets range from 0.0% to 22.6% with a mean of 0.4% (median 0.0%). One-year expected MDBP liability spillovers

as a percentage of market value of equity range from 0.0% to 69.6% with a mean of 1.4% (median 0.0%). For the 66 companies belonging exclusively to plans with less than 4 public firms, the mean 5-year expected MDBP liability spillover as a percentage of book assets is 0.8%, 2.1 times the mean 1-year expected MDBP liability spillover as a percentage of book assets. In Table 1.14, I present summary statistics for 1-year and 5-year expected MDBP liability spillovers.

In Table 1.15, I present expected MDBP liability spillover summary statistics by broad industry group for companies with no missing expected MDBP spillovers. Transportation has the largest mean expected MDBP liability spillover of $29.4 million (median $5.6 million) followed by mines/coal/oil with a mean of $18.6 million (median $19.1 million).

In Table 1.16, I present reported leverage ratios and leverage ratios consolidated with MDBP liabilities and expected MDBP liability spillovers for nonutility and nonfinancial MDBP companies with no missing plan expected MDBP spillovers, no missing leverage information, and positive book equity. For these 69 companies, Book D/A increases from a mean of 0.84 (median 0.82) to 0.88 (median 0.85) once unfunded MDBP liabilities and expected MDBP liability spillovers are consolidated, Market D/A increases from a mean of 0.47 (median 0.46) to 0.50 (median 0.48) once unfunded MDBP liabilities and expected MDBP liability spillovers are consolidated and Book D/(D+E) increases from a mean of 0.62 (median 0.60) to 0.66 (median 0.63) once unfunded MDBP liabilities and expected MDBP liability spillovers are consolidated. In sum, leverage ratios rise on average by about 6% once unfunded MDBP liabilities and expected MDBP liability spillovers are consolidated.

Fifteen public companies have 1-year expected MDBP liability spillovers bigger than 0.1% of their book assets; for these 15 companies, the mean 1-year expected MDBP liability spillovers as a percentage of book assets are 1.8% (median 0.2%). Two companies have 1-year expected MDBP liability spillovers larger than 1% of book assets, Arkansas Best (22.6%) and Walter Energy (1.7%). Five companies have 5-year expected MDBP liability spillovers bigger than 1% of book assets; for these, mean 5-year expected MDBP liability spillover as a percentage of total assets is 10.0% (median 0.7%).

It is important to remember that MDBPs expose public companies to potential MDBP liability spillovers from both private companies and non-Schedule R public companies. In my sample, on average, other public Schedule R companies' liabilities account for just 16.3% (median 7.4%) of the total MDBP liabilities that can spill over onto public companies from all other MDBP companies. Kroger disclosed that it contributed $7.0 million and Kelloggs disclosed that it contributed $3.6 million to the Central States in 2009[28] in their 2011 10-Ks but Kroger and Kelloggs do not appear on the 2009 Central States' Schedule R because their contributions are dwarfed by those of YRC Worldwide and Arkansas Best. Therefore, in my sample, calculated MDBP expected liability spillovers are most likely a small percentage of public companies' total expected MDBP liability spillovers from all MDBP sharing companies. On the other hand, my calculated MDBP expected liability spillovers do not account for positive competitive effects. I calculate that the expected liability spillover from Supervalu onto Kroger is $11 million.[29]

[28] Kroger and Kelloggs both deemed the Central States one of their significant MDBPs and disclosed this information in accordance with ASU 2011-09.
[29] At November 30, 2011.

1.8 Form 5500's Revelation of Expected MDBP Liability Spillovers to Market Participants

In order to document expected MDBP liability spillovers available to market participants from publicly available Form 5500 MDBP liability spillover information, I calculate expected MDBP liability spillovers on a monthly basis from July 30, 2010, to November 30, 2011. In Figure 1.5, I plot a graph of the aggregate expected MDBP spillovers revealed to market participants by Form 5500 filings. In Figure 1.6, I plot the aggregate MDBP spillovers revealed to the market by the four largest aggregate expected MDBP liability spillovers industry groups and in Table 1.17, I tabulate expected MDBP liability spillover summary statistics available to the market from Form 5500 filings on a monthly basis. Aggregate expected MDBP liability spillovers revealed to the market by Form 5500 filings peaked at the end of April 2011 at $558.0 million, the transportation sector accounted for nearly one half (48.1%) of the expected MDBP liability spillovers, food/retail sector for one third (33.8%) of the expected MDBP liability spillovers, and mines/coal/oil sector for 11.7% of the expected liability spillovers. LMS MDBP liability spillovers exist primarily between companies in the same broad industry group. In Figure 1.7, I illustrate the sources of LMS MDBP liability spillover risks for companies in the transportation and aircraft industry. In Figure 1.8, I illustrate the sources of LMS MDBP spillover risks for companies in the food/retail/drugs industry. In Figure 1.9, I illustrate the sources of LMS MDBP liability spillover risks for companies in mines/coal/oil industry. In Figure 1.10, I illustrate the sources of LMS MDBP liability spillover risks for companies in the construction/engineering/steel industry.

Expected MDBP liability spillovers exist primarily between companies in the same

broad industry group. At the end of April 2011, on average, 95.3% of expected spillover risks onto public companies were due to companies within the same broad industry group. In Figure 1.11, I illustrate the sources of expected MDBP liability spillover risks for companies in the transportation and aircraft industry. In Figure 1.12, I illustrate the sources of expected MDBP liability spillover risks for companies in the food/retail/drugs industry. In Figure 1.13, I illustrate the sources of expected MDBP liability spillover risks for companies in the mines/coal/oil industry. In Figure 1.14, I illustrate the sources of expected MDBP liability spillover risks for companies in the construction/engineering/steel industry.

1.9 Conclusion

In this chapter, I document the size and relevance of public companies' Schedule R MDBP liabilities, LMS, and expected MDBP liability spillovers from other Schedule R public companies. I also study the effect on public MDBP companies' leverage ratios of consolidating unfunded MDBP Schedule R liabilities and expected 1-year MDBP liability spillovers with reported debt. I document important expected liability spillovers in four different industries and show that MDBPs create important connections in U.S. unionized industries.

I find 154 public companies (144 incorporated in the U.S) listed on 2009 Schedule R Form 5500 filings. On average, MDBP public companies are three times bigger and 40% more leveraged than Compustat non-MDBP public companies. In aggregate, the 154 public companies are responsible for $23.9 billion MDBP liabilities with a mean company MDBP liability of $155.3 million (median $10.2 million). The distribution of public

companies' total MDBP liabilities is severely positively skewed; six companies have total MDBP liabilities of more than $1 billion. Forty-four (28%) of public companies have total MDBP liabilities bigger than 1% of their book assets, nine public companies have total MDBP liabilities outstripping 10% of their market value of equity, and three companies have total MDBP liabilities exceeding the market value of their equity.

Three industries are responsible for 86% of aggregate MDBP liabilities: transportation (51.8%), food/retail (29%), and mines/coal/oil (5.6%). Aggregate transportation industry MDBP liabilities are $12.4 billion; three companies account for 96% of these liabilities: UPS with $6.2 billion, YRC Worldwide with $4.6 billion, and Arkansas Best with $1.1 billion. Aggregate food/retail MDBP liabilities are $6.9 billion; three companies account for 83% of these liabilities: Safeway with $2.6 billion, Kroger with $2.0 billion, and Supervalu with $1.2 billion. Aggregate mines/coal/oil industry MDBP liabilities are $1.3 billion; all four mines/coal/oil companies have MDBP liabilities exceeding 3% of their market value of equity.

For the 2009 plan year, the mean public company total 1-year expected MDBP liability spillover is $5.3 million[30] (median $0.3 million). The distribution of 1-year expected MDBP liability spillovers is severely positively skewed; 13 companies have 1-year expected liability spillovers of more than $5 million and 51 companies have expected MDBP liability spillovers of less than $0.1 million. Five companies have 5-year expected MDBP liability spillovers exceeding 1% of book assets. On average, a firm's 5-year expected MDBP liability spillover is 2.6 times greater than its 1-year expected MDBP liability spillover.

[30] Seventy-five companies with no missing expected MDBP spillovers used to calculate mean and median.

Aggregate expected 1-year MDBP liability spillovers revealed to the market by Form 5500 filings peaked at the end of April 2011 at $558.0 million, the 1-year expected MDBP liability spillover from YRC Worldwide onto Arkansas Best accounted for 39% of the aggregate 1-year expected MDBP liability spillover, the food/retail sector for one third (33.8%) of the aggregate 1-year MDBP liability expected spillover, and the mines/coal/oil sector for 11.7% of the aggregate 1-year MDBP liability expected spillover.

Book D/A increases from a mean of 0.84 (median 0.83) to 0.87 (median 0.84) once unfunded MDBP liabilities are consolidated with reported debt. On average, leverage ratios increase by 4% once unfunded MDBP liabilities are consolidated with reported debt. Book D/A increases from a mean of 0.84 (median 0.82) to 0.88 (median 0.85) once unfunded MDBP liabilities and 1-year expected MDBP liability spillovers are consolidated with reported debt. On average, leverage ratios increase by 6% once unfunded MDBP liabilities and 1-year expected MDBP liability spillovers are consolidated with reported debt.

Table 1.1 Illustration of the Five Spillover Events in the 5-Year Two Public Company Case

Bankruptcy Event					
Year					Spillover Event
1	2	3	4	5	Description
B					B goes bankrupt in 1st year and A survives for 5 years
	B				B goes bankrupt in 2nd year and A survives for 5 years
		B			B goes bankrupt in 3rd year and A survives for 5 years
			B		B goes bankrupt in 4th year and A survives for 5 years
				B	B goes bankrupt in 5th year and A survives for 5 years

Table 1.2. Calculation of Discounted Expected 5-Year Spillovers
where r = 1-year discount rate and $SLMS_{A,B,1}$ is the LMS MDBP spillover onto A when B goes bankrupt in the first year

Bankrupt Company Year					**Event**	**Discounted**	**Discounted Expected**
1	**2**	**3**	**4**	**5**	**Probability**	**Spillover ($m)**	**Spillover ($m)**
B					$P_{E1}=(1-p_A)^5 \times p_B$	$SLMS_{A,B,1}$	$P_{E1} \times SLMS_{A,B,1}$
	B				$P_{E2}= (1-p_A)^5 \times (1-p_B) \times p_B$	$SLMS_{A,B,2}/(1+r)$	$P_{E2} \times SLMS_{A,B,2}/(1+r)$
		B			$P_{E3}=(1-p_A)^5 \times (1-p_B)^2 \times p_B$	$SLMS_{A,B,,3//}/(1+r)^2$	$P_{E3} \times SLMS_{A,B,,3}/(1+r)^2$
			B		$P_{E4}=(1-p_A)^5 \times (1-p_B)^3 \times p_B$	$SLMS_{A,B,,3}/(1+r)^3$	$P_{E4} \times SLMS_{A,B,,3} /(1+r)^3$
				B	$P_{E5}=(1-p_A)^5 \times (1-p_B)^4 \times p_B$	$SLMS_{A,B,,5}/(1+r)^4$	$P_{E5} \times SLMS_{A,B,,5.} /(1+r)^4$.

Table 1.3. Three Public Company Spillover Events Over a 5-Year Period

Bankruptcy Event Year					Spillover Event Description
1	2	3	4	5	
B					B goes bankrupt in the 1st year and A and C survive for 5 years
C					C goes bankrupt in the 1st year and A and B survive for 5 years
BC					B and C go bankrupt in the 1st year and A survives for 5 years
	B				B goes bankrupt in the 2nd year and A and C survive for 5 years
	C				C goes bankrupt in the 2nd year and A and B survive for 5 years
	BC				B and C go bankrupt in the 2nd year and A survives for 5 years
B	C				B goes bankrupt in the 1st year, C goes bankrupt in the 2nd year and A survives for 5 years
C	B				C goes bankrupt in the 1st year, B goes bankrupt in the 2nd year and A survives for 5 years
		B			B goes bankrupt in the 3rd year and A and C survive for 5 years
		C			C goes bankrupt in the 3rd year and A and B survive for 5 years
		BC			B and C go bankrupt in the 3rd year and A survives for 5 years
	B	C			B goes bankrupt in the 2nd year, C goes bankrupt in the 3rd year and A survives for 5 years
	C	B			C goes bankrupt in the 2nd year, B goes bankrupt in the 3rd year and A survives for 5 years
B		C			B goes bankrupt in the 1st year, C goes bankrupt in the 3rd year and A survives for 5 years
C		B			C goes bankrupt in the 1st year, B goes bankrupt in the 3rd year and A survives for 5 years
			B		B goes bankrupt in the 4th year and A and C survive for 5 years
			C		C goes bankrupt in the 4th year and A and B survive for 5 years
			BC		B and C go bankrupt in the 3rd year and A survives for 5 years
		B	C		B goes bankrupt in the 3rd year, C goes bankrupt in the 4th year and A survives for 5 years
		C	B		C goes bankrupt in the 3rd year, B goes bankrupt in the 4th year and A survives for 5 years
	B		C		B goes bankrupt in the 2nd year, C goes bankrupt in the 4th year and A survives for 5 years
	C		B		C goes bankrupt in the 2nd year, B goes bankrupt in the 4th year and A survives for 5 years
B			C		B goes bankrupt in the 1st year, C goes bankrupt in the 4th year and A survives for 5 years
C			B		C goes bankrupt in the 1st year, B goes bankrupt in the 4th year and A survives for 5 years
				B	B goes bankrupt in the 5th year and A and C survive for 5 years
				C	C goes bankrupt in the 5th year and A and B survive for 5 years
				BC	B and C go bankrupt in the 5th year and A survives for 5 years

Table 1.3. Continued

Bankruptcy Event Year					Spillover Event Description
1	2	3	4	5	
			B	C	B goes bankrupt in the 4th year, C goes bankrupt in the 5th year and A survives for 5 years
			C	B	C goes bankrupt in the 4th year, B goes bankrupt in the 5th year and A survives for 5 years
		B		C	B goes bankrupt in the 3rd year, C goes bankrupt in the 5th year and A survives for 5 years
		C		B	C goes bankrupt in the 3rd year, B goes bankrupt in the 4th year and A survives for 5 years
	B			C	B goes bankrupt in the 2nd year, C goes bankrupt in the 5th year and A survives for 5 years
	C			B	C goes bankrupt in the 2nd year, B goes bankrupt in the 5th year and A survives for 5 years
B				C	B goes bankrupt in the 1st year, C goes bankrupt in the 5th year and A survives for 5 years
C				B	C goes bankrupt in the 1st year, B goes bankrupt in the 5th year and A survives for 5 years

Table 1.4 Schedule R Company Matches to Public Companies

Matching Method	Number of observations
Employer EIN	85
Exhibit 21	202
10-K	32
Company website	42
Same Employer EIN as 401K of Public Company	28
Same employer EIN as company already matched	15
Other (court documents, news stories, EIN match using EIN finder)	125
Total number of public company observations	**529**

Table 1.5 Distribution of Number of Companies Listed on an Individual MDBP's Schedule R

Number in Plan	Number of Plans	Percentage (%)
1	29	8.7
2	44	13.2
3	63	18.9
4	63	18.9
5	60	18.0
6	48	14.4
7	18	5.4
8	4	1.2
9	3	0.9
18	1	0.3
Total	**333**	**100**

Table 1.6 Distribution of Number of Public Companies Listed on an Individual MDBP's Schedule R

Number of Public Companies	Number of Plans	Percentage (%)
1	218	65.5
2	82	24.6
3	29	8.7
4	1	0.3
5	2	0.6
6	1	0.3
Total	**333**	**100**

Table 1.7 Public MDBP Company Summary Statistics

Panel A Descriptive Statistics

	MDBP Public Companies 141 observations		**Non-MDBP Public Companies 4,429 observations**	
	Mean	Median	Mean	Median
Market Value of Equity ($ millions)	15,568	3,601	5,002	563
Log of book assets	8.6	8.6	6.9	6.6
Market to Book Ratio	3.7	1.8	5.7	1.7
	131 observations		**3,271 observations**	
	Mean	Median	Mean	Median
Negative Altman Z-score	-3.01	-2.66	-5.10	-3.11
Z -Probability	0.10	0.07	0.14	0.04

Panel B : Broad Industry Groups

Broad Industry Group	**No of Public Companies**	**Percentage (%)**
Aircraft	5	3.2
Construction/Engineering/Steel	27	17.5
Entertainment/Printing	20	13.0
Food/Retail	27	17.5
Hotels/Casinos	2	1.3
Mines/Coal/Oil	4	2.6
Paper/Paperboard	4	2.6
Transportation	13	8.4
Waste Management	6	3.9
Other	46	29.9
Total	154	100.0

Table 1.8 Total Public Company Liability Summary Statistics by Broad Industry Group

Broad Industry Group	N	Company Liabilities ($ millions) Mean	Median	Sum	Percentage of Total (%)
Aircraft	5	96.4	14.4	482.1	2.0
Construction/Engineering/Steel	27	31.5	2.9	851.3	3.6
Entertainment/Printing	20	48.3	15.5	965.6	4.0
Food/Retail	27	257.1	19.4	6,942.9	29.0
Hotels/Casinos	2	7.5	7.5	15	0.1
Mines/Coal/Oil	4	330.7	265.4	1,332.8	5.6
Paper/Paperboard	4	27.6	24.6	110.5	0.5
Transportation	13	953.4	71.8	12,394.4	51.8
Waste Management	6	22.8	19.4	136.6	0.6
Other	46	15.1	6.4	696	2.9
Total	154			23927.2	100.0

Table 1.9 Public Companies With MDBP Liabilities Exceeding $120 million for the 2009 PlanYear

Company Name	MDBP liability ($ millions)	Market Value of Equity ($ millions)	Total Assets ($ millions)	No of Plans	MDBP Liability as a Percentage of Market Value of Equity (%)	MDBP Liability as a Percentage of Book Assets (%)
UNITED PARCEL SERVICE	6,194.8	71,645	33,597	23	8.6	18.4
YRC WORLDWIDE	4,584.4	177	2,593	9	2,591.1	176.8
SAFEWAY	2,554.4	8,276	15,148	16	30.9	16.9
KROGER	2,003.1	13,268	23,505	19	15.1	8.5
SUPERVALU	1,189.6	1,830	13,758	21	65.0	8.6
ARKANSAS BEST	1,145.1	693	861	8	165.3	133.0
CONSOL ENERGY	652.5	11,023	12,071	1	5.9	5.4
GREAT ATLANTIC and PACIFIC TEA	317.7	13	2,645	10	2,360.8	12.0
UNITED TECHNOLOGIES	310.3	72,522	58,493	1	0.4	0.5
DISNEY (WALT)	309.4	62,787	69,206	15	0.5	0.4
EMCOR GROUP	276.9	1932	2,756	35	14.3	10.0
NEWS CORP	267.3			9		
WALTER ENERGY	266.3	6,793	1,658	1	3.9	16.1
ALPHA NATURAL RESOURCES	264.5	7,233	5,179	1	3.7	5.1
KRAFT FOODS	247.1		21,598	2		1.1
HILLSHIRE BRANDS	240.7	9,336	8,836	5	2.6	2.7
UNITED CONTINENTAL	164.8	7,811	39,598	1	2.1	0.4
SPIRIT AEROSYSTEMS	155.0	2,957	5,102	1	5.2	3.0
BABCOCK and WILCOX	146.7	2,991	2,501	1	4.9	5.9
PATRIOT COAL	139.4	1,762	3,810	1	7.9	3.7
US STEEL	130.4	8,393	15,350	1	1.6	0.8
ARCELORMITTAL	127.2	59,047	130,904	1	0.2	0.1

Table 1.10 Leverage Characteristics of MDBP Companies and Non-MDBP Companies

	MDBP Companies 131 Companies		**Non-MDBP Companies** 3,369 Companies	
	Mean	**Median**	**Mean**	**Median**
MDBP liability as a percentage of Long Term Debt (%)	4.91	0.39		
Book D/A	0.84	0.83	0.66	0.65
Book D/A consolidated with MDBP Liability	0.87	0.84		
Market D/A	0.46	0.46	0.30	0.27
Market D/A consolidated with MDBP Liability	0.48	0.47		
Book D/(D+E)	0.61	0.59	0.44	0.44
Book D/(D+E) consolidated with MDBP Liability	0.63	0.60		
Market Value of Equity ($ millions)	13,329	3,213	5,121	591
Log of Total Book Assets	8.5	8.5	6.3	6.2
Market to Book Ratio	3.8	1.9	7.0	2.1

Table 1.11 Distribution of the Number of MDBPs Exposing Public Companies to Public Company MDBP Liability Spillovers

Number of Plans	**Number of Companies**	**Percentage**
0	51	33.1
1	58	37.7
2	17	11.0
3	9	5.8
4	3	1.9
5	3	1.9
6	1	0.6
7	5	3.2
8	1	0.6
10	1	0.6
11	1	0.6
12	1	0.3
14	2	1.3
15	1	0.6
Total	**154**	**100**

Table 1.12 Schedule R Public Companies with 1-Year Expected MDBP Liability Spillovers Exceeding One Million Dollars

Company Name	Expected 1-year Liability Spillover ($ millions)	Book Assets ($ millions)	No of Spillover Plans	No of Missing Spillover Plans	Liability Spillover as a Percentage of Book Assets (%)
ARKANSAS BEST	194.5	861	7	0	22.6
WALTER ENERGY	28.1	1,658	1	0	1.7
KROGER	24.7	23,505	15	0	0.1
ALPHA NATURAL RESOURCES	24.7	5,179	1	0	0.5
UNITED PARCEL SERVICE	17.2	33,597	7	0	0.1
SAFEWAY	15.9	15,148	14	1	0.1
SUPERVALU	14.9	13,758	14	0	0.1
CONSOL ENERGY	13.5	12,071	1	0	0.1
SPIRIT AEROSYSTEMS	10.7	5,102	1	0	0.2
GREAT ATLANTIC and PACIFIC TEA	9.4	2,645	7	0	0.4
YRC WORLDWIDE	8.2	2,593	7	0	0.3
PATRIOT COAL CORP	8.2	3,810	1	0	0.2
US AIRWAYS GROUP	6.4	7,819	1	0	0.1
UNITED CONTINENTAL	4.7	39,598	1	0	0.0
UNITED STATES STEEL	3.8	15,350	1	0	0.0
DELTA AIR LINES	3.7	43,188	1	0	0.0
ARCELORMITTAL SA	3.5	130,904	1	0	0.0
SYSCO CORP	3.0	10,314	3	0	0.0
WYNN RESORTS	2.9	6,674	1	0	0.0
STEINWAY MUSICAL INSTRUMENTS	1.8	485	1	0	0.4
DISNEY (WALT)	1.8	69,206	10	4	0.0
WASTE MANAGEMENT	1.5	21,476	3	0	0.0
REPUBLIC SERVICES	1.2	19,462	2	0	0.0

Table 1.13 LMS and 1-Year Expected Liability MDBP Spillovers

		Spillover in $millions			Spillover as a Percentage of Book Assets		
	N	**Mean**	**Median**	**Maximum**	**Mean**	**Median**	**Maximum**
LMS Spillover	75	119.2	17.2	2,223.5	3.3	0.2	92.6
One-year Expected Spillover	75	5.3	0.3	194.5	0.4	0.0	22.6

Table 1.14 One-Year and 5-Year Expected Liability MDBP Spillovers

		Spillover in $millions			Spillover as a Percentage of Book Assets		
	N	**Mean**	**Median**	**Maximum**	**Mean**	**Median**	**Maximum**
One-year Expected Spillover	66	4.3	0.1	194.5	0.4	0.0	22.6
Five-year Expected Spillover	66	10.1	0.4	410.8	0.8	0.0	47.7

Table 1.15 Expected 1-Year MDBP Liability Spillovers Summary Statistics by Broad Industry Group
(Companies with no missing expected MDBP liability spillovers)

				Total 1-Year Expected MDBP Liability Spillover as a			
		Total 1-Year Expected MDBP Liability Spillover ($ millions)		Percentage of Book Total Assets (%)		Percentage of Market Value of Equity (%)	
Broad Industry Group	**N**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**
Aircraft	3	3.59	0.02	0.07	0.00	0.12	0.00
Construction/Engineering/Steel	13	0.69	0.09	0.01	0.00	0.01	0.00
Entertainment/Printing	11	0.36	0.07	0.01	0.00	0.01	0.00
Food/Retail	14	3.94	0.46	0.07	0.01	5.06	0.01
Hotels/Casinos	0						
Mines/Coal/Oil	4	18.61	19.1	0.62	0.35	0.34	0.38
Paper/Paperboard	4	0.36	0.36	0.01	0.00	0.03	0.01
Transportation	8	29.42	5.59	2.88	0.03	4.16	0.05
Waste Management	6	0.64	0.54	0.01	0.00	0.01	0.01
Other	12	0.35	0.09	0.04	0.00	0.08	0.00
Total	**75**						

Table 1.16 Leverage of MDBP Liability Spillover Public Companies and Non-MDBP Public Companies

	MDBP with Liability Spillover Risks 69 Companies		**Non-MDBP Companies** 3,369 Companies	
	Mean	**Median**	**Mean**	**Median**
MDBP Liability and Liability Spillover as a percentage of Long Term Debt	8.39	0.45		
Book D/A	0.84	0.82	0.66	0.65
Book D/A consolidated with MDBP liability and Liability Spillover	0.88	0.85		
Market D/A	0.47	0.46	0.30	0.27
Market D/A consolidated with MDBP Liability and Liability Spillover	0.50	0.48		
Book D/(D+E)	0.62	0.60	0.44	0.44
Book D/(D+E) consolidated with MDBP Liability and Liability Spillover	0.66	0.63		
Market Value of Equity ($ millions)	15,987	3,601	5,121	591
Log of Total Book Assets	8.7	8.7	6.3	6.2
Market to Book Ratio	3.2	1.9	7.0	2.1

Table 1.17 Expected 1-Year MDBP Liability Spillovers Revealed to the Market by Form 5500 Filings

	No of Plans Filed	No of Spillover Risk Plans Filed	No of Public Companies subject to Spillovers Risks	Mean Expected Independent Spillover Risk ($ millions)	Median Expected Independent Spillover Risk ($ millions)	75th Percentile Expected Independent Spillover Risk ($ millions)	Maximum Expected Independent Spillover Risk ($ millions)	Mean Independent Spillover Risk as a Percentage of Total Book Assets (%)
30-Jul-10	3	1	2	0.01	0.01	0.02	0.0	0.00
31-Aug-10	11	4	8	0.65	0.04	0.92	3.3	0.05
30-Sep-10	17	6	13	0.60	0.10	0.55	3.3	0.04
29-Oct-10	200	70	73	5.65	0.13	3.13	211.3	0.46
30-Nov-10	203	70	73	5.65	0.13	3.13	211.3	0.46
31-Dec-10	211	72	75	5.49	0.16	2.76	211.3	0.45
31-Jan-11	230	78	79	7.06	0.24	1.91	213.6	0.46
28-Feb-11	247	82	83	6.85	0.24	1.57	213.6	0.45
31-Mar-11	265	85	83	6.85	0.24	1.51	213.8	0.45
29-Apr-11	300	101	94	7.25	0.20	1.79	221.7	0.42
31-May-11	305	103	96	6.52	0.20	0.99	194.5	0.36
30-Jun-11	314	105	98	6.34	0.18	0.99	194.5	0.35
29-Jul-11	325	109	102	6.26	0.18	1.25	194.5	0.34
31-Aug-11	330	111	102	6.27	0.17	1.25	195.0	0.35
30-Sep-11	335	114	103	6.38	0.16	1.51	195.0	0.34
31-Oct-11	357	110	98	6.46	0.17	1.02	195.0	0.35
30-Nov-11	358	110	98	6.46	0.17	1.02	195.0	0.35

Bankruptcy Event Year					Event	Discounted	Discounted Expected
1	2	3	4	5	Probability	Spillover ($m)	Spillover ($m)
B					$0.9 \times 0.2 \times 0.7 \times (0.9 \times 0.7)^4 = 0.020$	90	$0.020 \times 90 = 1.79$
C					$0.9 \times 0.8 \times 0.3 \times (0.9 \times 0.8)^4 = 0.058$	120	$0.058 \times 120 = 6.97$
BC					$0.9 \times 0.2 \times 0.3 \times 0.9^4 = 0.035$	294.55	$0.035 \times 294.55 = 10.44$
	B				$0.9 \times 0.8 \times 0.7 \times 0.9 \times 0.2 \times 0.7 \times (0.9 \times 0.7)^3 = 0.016$	$90/1.05 = 85.71$	$0.016 \times 85.71 = 1.36$
	C				$0.9 \times 0.8 \times 0.7 \times 0.9 \times 0.8 \times 0.3 \times (0.9 \times 0.8)^3 = 0.041$	$120/1.05 = 114.29$	$0.041 \times 114.29 = 4.64$
	BC				$0.9 \times 0.8 \times 0.7 \times 0.9 \times 0.2 \times 0.3 \times 0.9^3 = 0.020$	$294.55/1.05 = 280.52$	$0.020 \times 280.52 = 5.57$
B	C				$0.9 \times 0.2 \times 0.7 \times 0.9 \times 0.3 \times 0.9^3 = 0.025$	$90 + 204.55/1.05 = 284.81$	$0.025 \times 284.81 = 7.06$
C	B				$0.9 \times 0.8 \times 0.3 \times 0.9 \times 0.2 \times 0.9^3 = 0.028$	$120 + 174.55/1.05 = 286.24$	$0.028 \times 286.24 = 8.11$
		B			$(0.9 \times 0.8 \times 0.7)^2 \times 0.9 \times 0.2 \times 0.7 \times (0.9 \times 0.7)^2 = 0.013$	$90/1.05^2 = 81.63$	$0.013 \times 81.63 = 1.04$
		C			$(0.9 \times 0.8 \times 0.7)^2 \times 0.9 \times 0.8 \times 0.3 \times (0.9 \times 0.8)^2 = 0.028$	$120/1.05^2 = 108.84$	$0.028 \times 108.84 = 3.10$
		BC			$(0.9 \times 0.8 \times 0.7)^2 \times 0.9 \times 0.2 \times 0.3 \times 0.9^2 = 0.011$	$294.55/1.05^2 = 267.17$	$0.011 \times 267.17 = 2.97$
	B	C			$0.9 \times 0.8 \times 0.7 \times 0.9 \times 0.2 \times 0.7 \times 0.9 \times 0.3 \times 0.9^2 = 0.014$	$90/1.05 + 204.55/1.05^2 = 271.25$	$0.014 \times 271.25 = 3.77$
	C	B			$0.9 \times 0.8 \times 0.7 \times 0.9 \times 0.8 \times 0.3 \times 0.9 \times 0.2 \times 0.9^2 = 0.016$	$120/1.05 + 174.55/1.05^2 = 272.61$	$0.016 \times 272.61 = 4.33$
B		C			$0.9 \times 0.2 \times 0.7 \times 0.9 \times 0.7 \times 0.9 \times 0.3 \times 0.9^2 = 0.0174$	$90 + 204.55/1.05^2 = 275.53$	$0.0174 \times 275.53 = 4.78$
C		B			$0.9 \times 0.8 \times 0.3 \times 0.9 \times 0.8 \times 0.9 \times 0.2 \times 0.9^2 = 0.023$	$120 + 174.55/1.05^2 = 278.32$	$0.023 \times 278.32 = 6.31$
			B		$(0.9 \times 0.8 \times 0.7)^3 \times 0.9 \times 0.2 \times 0.7 \times 0.9 \times 0.7 = 0.010$	$90/1.05^3 = 77.75$	$0.010 \times 77.75 = 0.79$
			C		$(0.9 \times 0.8 \times 0.7)^3 \times 0.9 \times 0.8 \times 0.3 \times 0.9 \times 0.8 = 0.020$	$120/1.05^3 = 103.66$	$0.020 \times 103.66 = 2.06$
			BC		$(0.9 \times 0.8 \times 0.7)^3 \times 0.9 \times 0.2 \times 0.3 \times 0.9 = 0.006$	$294.55/1.05^3 = 254.44$	$0.006 \times 254.44 = 1.58$
		B	C		$(0.9 \times 0.8 \times 0.7)^2 \times 0.9 \times 0.2 \times 0.7 \times 0.9 \times 0.3 \times 0.9 = 0.008$	$90/1.05^2 + 204.55/1.05^3 = 258.33$	$0.008 \times 258.33 = 2.01$
		C	B		$(0.9 \times 0.8 \times 0.7)^2 \times 0.9 \times 0.8 \times 0.3 \times 0.9 \times 0.2 \times 0.9 = 0.009$	$120/1.05^2 + 174.55/1.05^3 = 259.63$	$0.009 \times 259.63 = 2.31$

Figure 1.1. Calculation of Discounted Expected 5-Year MDBP Liability Spillovers in the Three Public Company MDBP Case.

Bankruptcy Event Year					Event	Discounted	Discounted Expected
1	2	3	4	5	Probability	Spillover ($m)	Spillover ($m)
	B		C		0.9x0.8x0.7x0.9x0.2x0.7x0.9x0.7x0.9x0.3x0.9=0.010	90/1.05+204.55/1.05^3=262.41	0.010x262.41=2.55
	C		B		0.9x0.8x0.7x0.9 x0.8 x 0.3 x0.9 x0.8 x0.9x0.2x0.9=0.013	120/1.05+174.55/1.05^3=265.07	0.013x265.07=3.37
B			C		0.9 x0.2x0.7x$(0.9x0.7)^2$x0.9x0.3X0.9=0.012	90+204.55/1.05^3=266.70	0.012x266.70=3.24
C			B		0.9x0.8x0.3x$(0.9x0.8)^2$x0.9x0.2x0.9=0.018	120+174.55/1.05^3=270.78	0.018x270.78=4.91
				B	$(0.9x0.8x0.7)^4$ x 0.9x0.2 x0.7	90/1.05^4=74.04	0.008x74.04=0.60
				C	$(0.9x0.8x0.7)^4$x0.9 x 0.8 x0.3=0.014	120/1.05^4=98.72	0.014x98.72=1.38
				BC	$(0.9x0.8x0.7)^4$x0.9 x 0.2 x0.3=0.003	294.55/1.05^4=242.33	0.003x242.33=0.84
			B	C	$(0.9x0.8x0.7)^3$x0.9 x 0.2 x0.7 x0.9 x0.3=0.004	90/1.05^3+204.55/1.05^4=246.03	0.004x246.03=1.07
			C	B	(0.9x0.8x0.7)^3x0.9 x 0.8 x0.3 x0.9 x0.2=0.005	120/1.05^3+174.55/1.05^4=247.26	0.005x247.26=1.23
		B		C	$(0.9x0.8x0.7)^2$x0.9x0.2x0.7x0.9x0.7x0.9x0.3=0.005	90/1.05^2+204.55/1.05^4=249.92	0.005x249.92=1.36
		C		B	$(0.9x0.8x0.7)^2$x0.9 x0.8 x 0.3 x0.9 x0.8 x0.9x0.2=0.007	120/1.05^2+174.55/1.05^4=252.44	0.007x252.44=1.80
	B			C	0.9x0.8x0.7x0.9 x0.2x0.7x$(0.9x0.7)^2$x0.9x0.3=0.007	90/1.05+204.55/1.05^4=254.00	0.007x254.00=1.73
	C			B	0.9x0.8x0.7x0.9x0.8x0.3x$(0.9x0.8)^2$x0.9x0.2=0.010	120/1.05+174.55/1.05^4=257.89	0.010x257.89=2.62
B				C	0.9x0.2x0.7x$(0.9 x0.7)^3$x0.9x0.3=0.009	90+204.55/1.05^4=258.28	0.009x258.28=2.20
C				B	0.9x0.8x0.3x$(0.9 x0.8)^3$x0.9x0.2=0.015	120+174.55/1.05^4=263.60	0.015x263.60=3.83
						Total Expected Spillover	**$114 million**

Figure 1.1. Continued

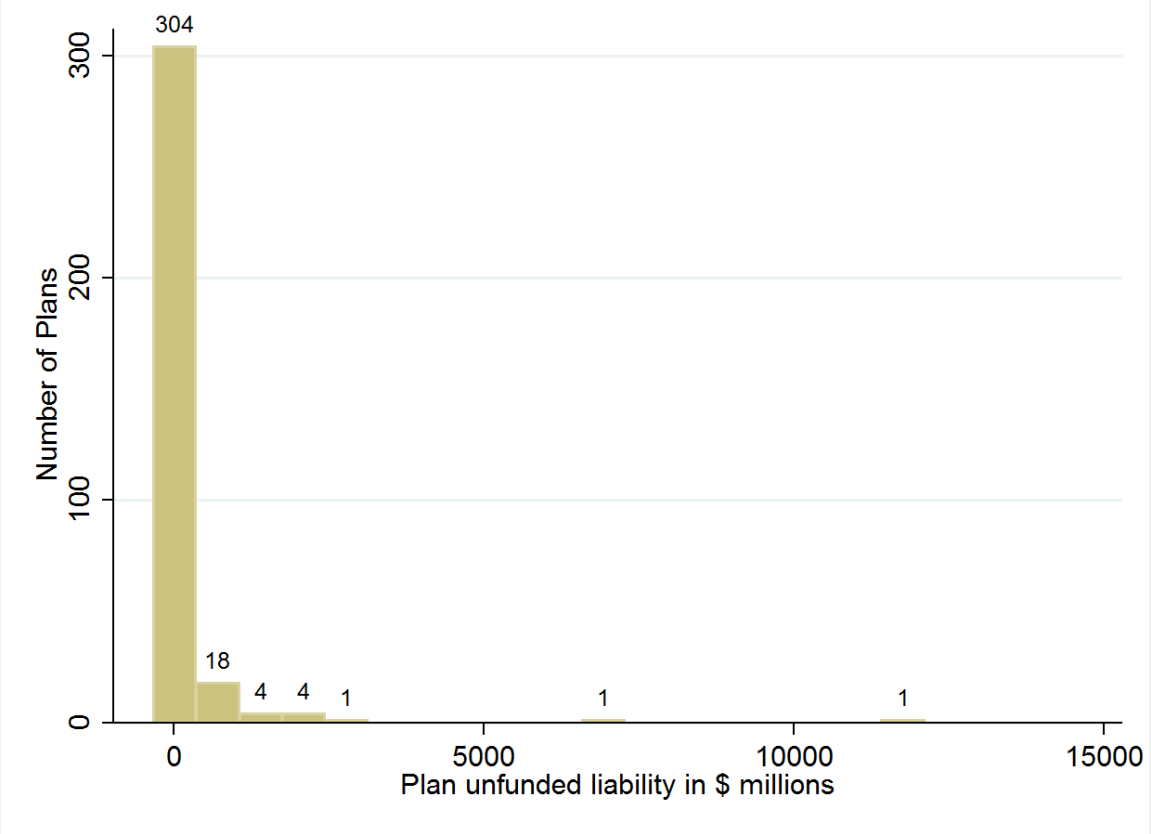

Figure 1.2. Histogram Showing the Distribution of Plan Unfunded Liabilities.

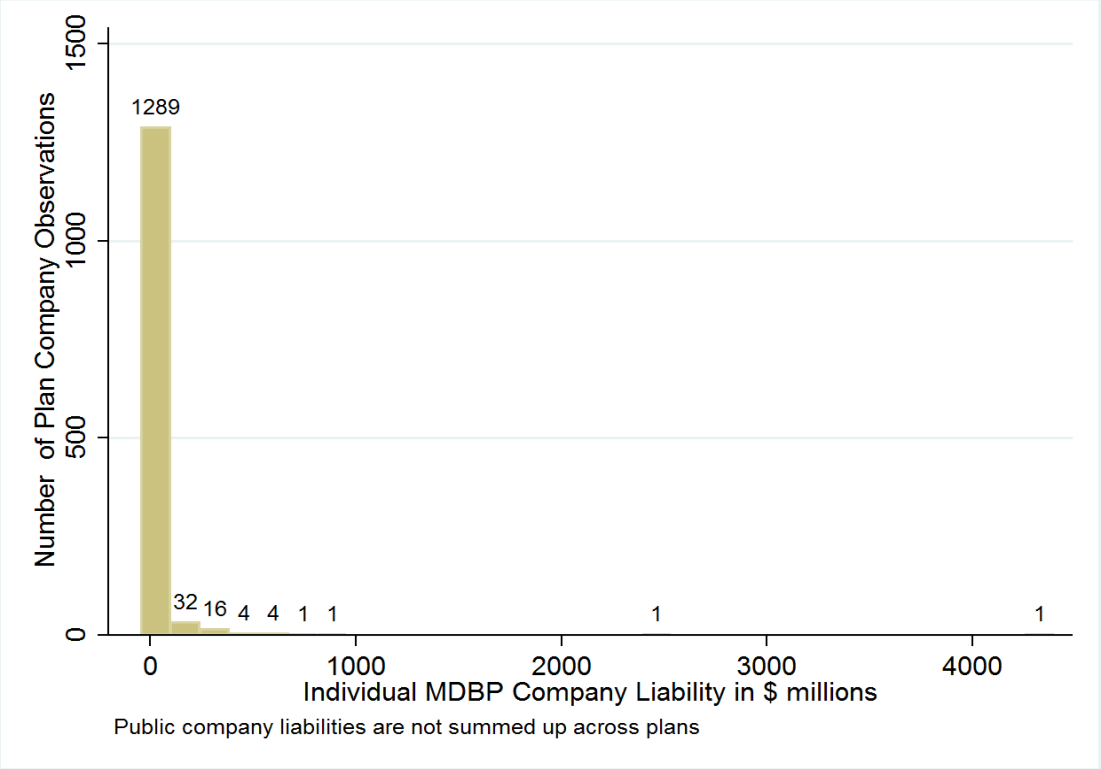

Figure 1.3. Histogram of Individual Companies' Unfunded MDBP Liability.

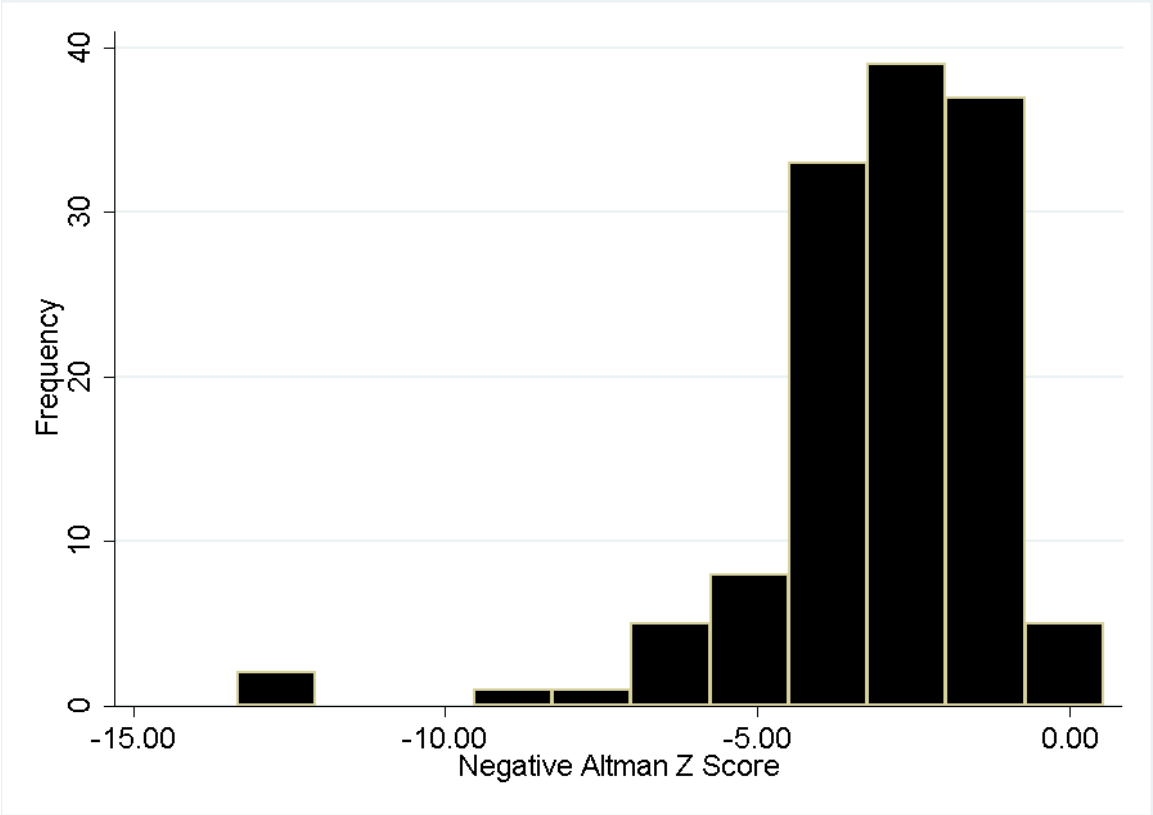

Figure 1.4. Histogram of Negative Altman Z-scores.

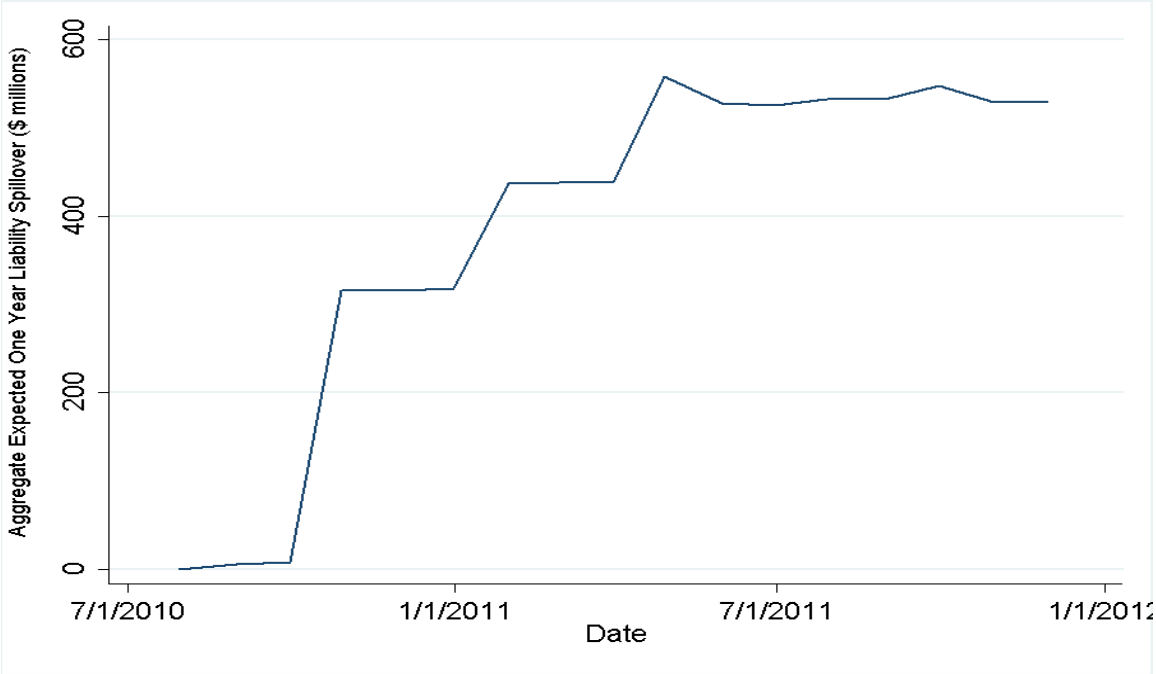

Figure 1.5. Aggregate 1-Year Expected MDBP Liability Spillovers Revealed to Market Participants by Form 5500 Filings.

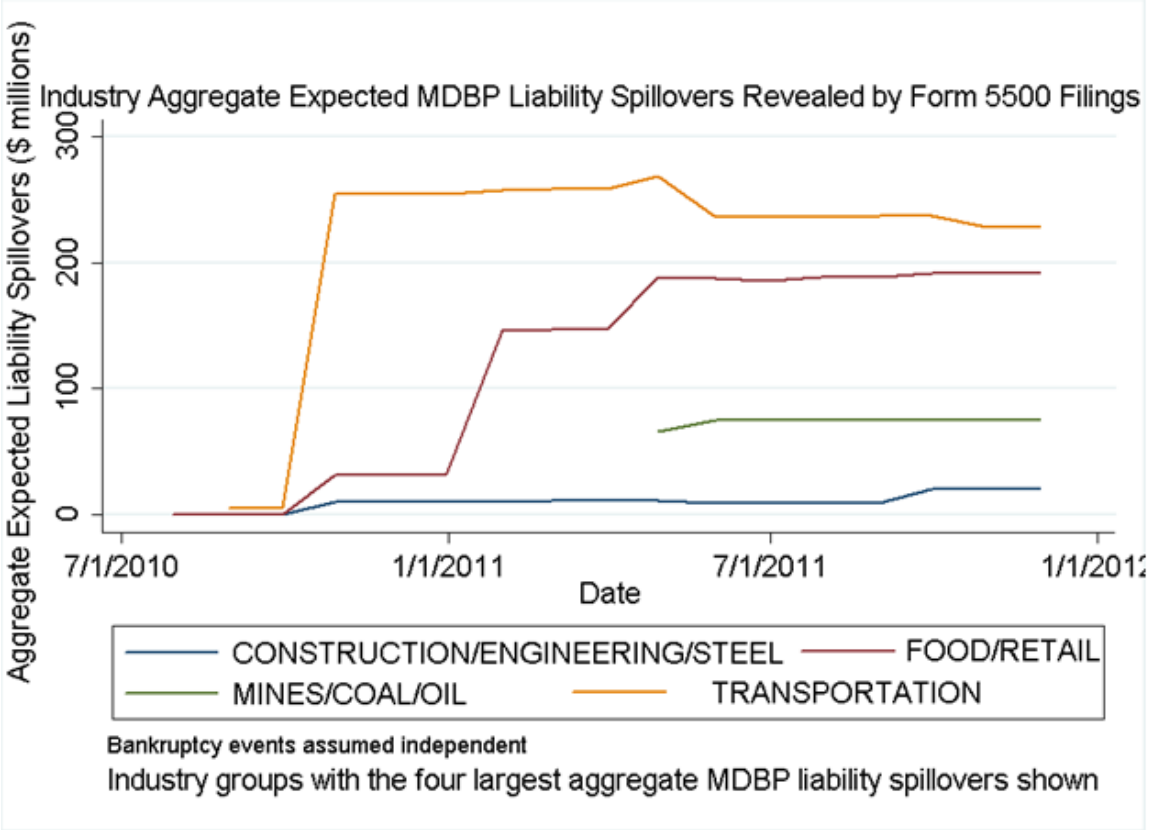

Figure 1.6 Aggregate Industry 1-Year Expected MDBP Liability Spillovers Revealed by Form 5500 Filings.

Figure 1.7. Sources of LMS Spillovers Onto Transportation/Aircraft Industry Companies.
I show only LMS spillovers of more than $50 million or more than 1% of the company's value of market equity as at November 30, 2011. When two companies share more than one MDBP, I show the number of MDBPs shared in red.

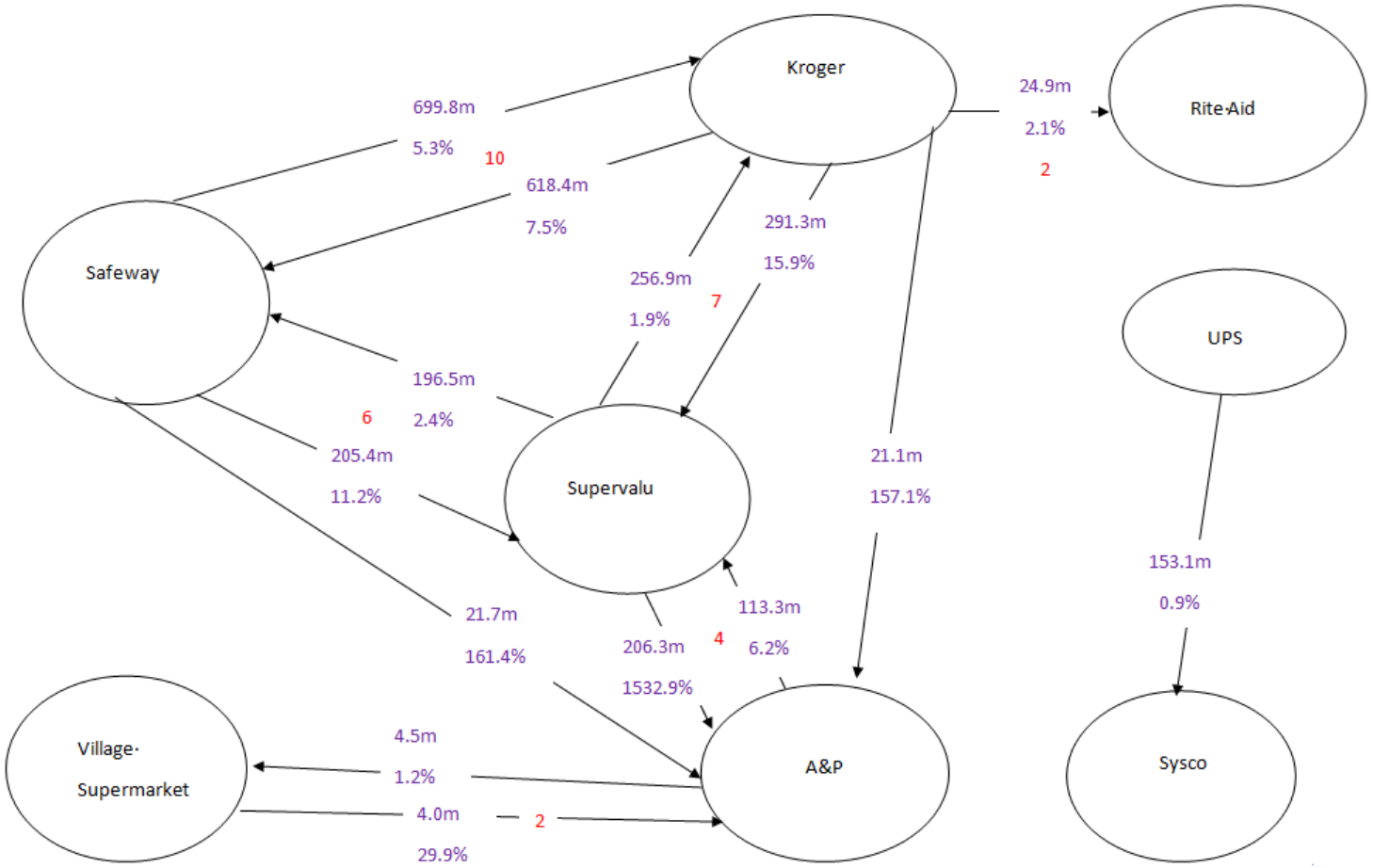

Figure 1.8. Sources of LMS MDBP Liability Spillovers Onto Food/Retail/Drugs Companies.
I show only LMS spillovers of more than $50 million or more than 1% of the company's value of market equity as at November 30, 2011. When two companies share more than one MDBP, I show the number of MDBPs shared in red.

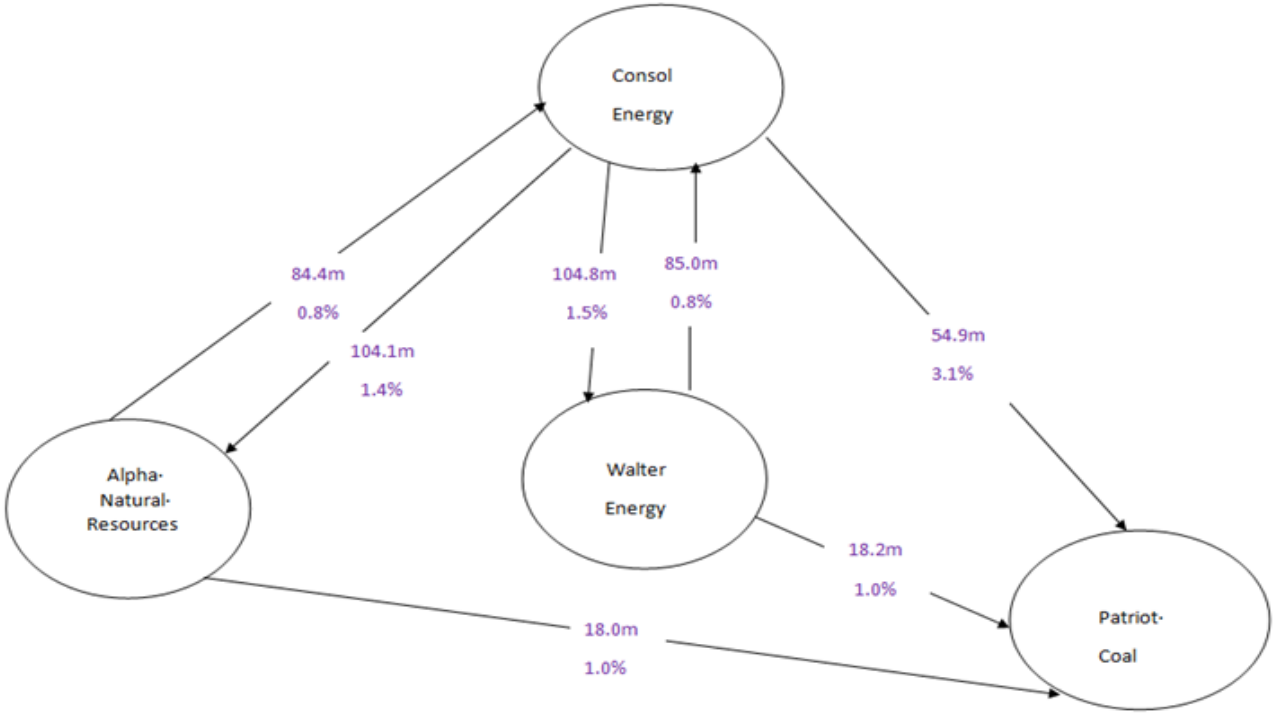

Figure 1.9. Sources of LMS MDBP Liability Spillovers Onto Mines/Coal/Oil Companies.
I show only LMS spillovers of more than $50 million or more than 1% of the company's value of market equity as at November 30, 2011. When two companies share more than one MDBP, I show the number of MDBPs shared in red.

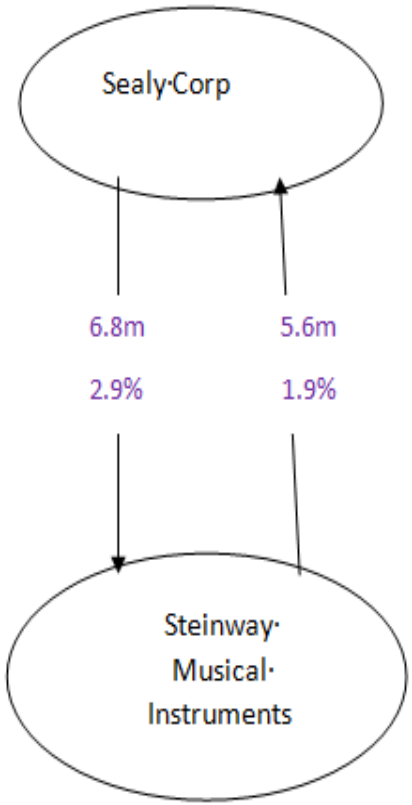

Figure 1.10. Sources of LMS MDBP Liability Spillovers Onto Manufacturing Companies.
I show only LMS spillovers of more than $50 million or more than 1% of the company's value of market equity as at November 30, 2011. When two companies share more than one MDBP, I show the number of MDBPs shared in red.

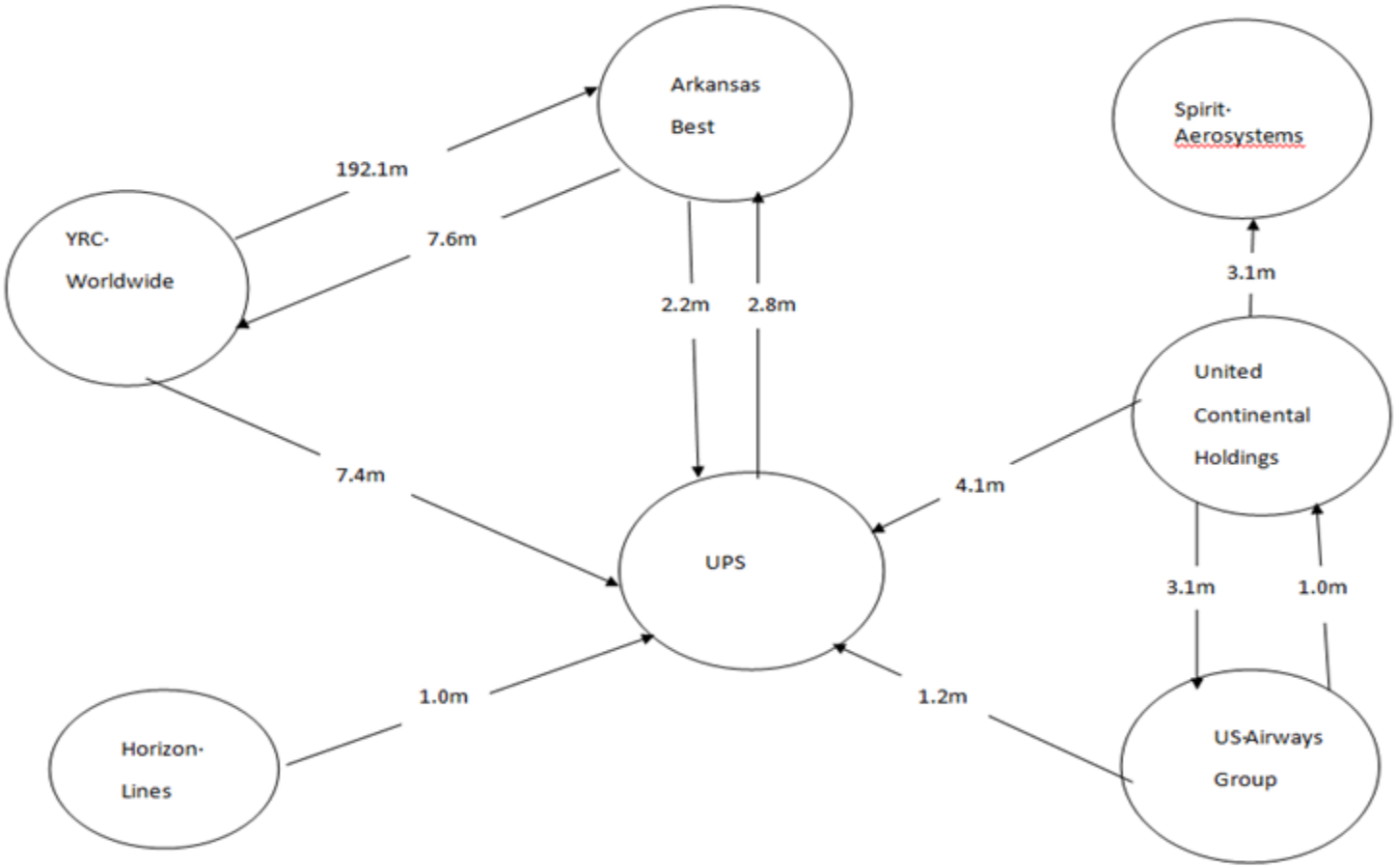

Figure 1.11. Sources of 1-Year Expected MDBP Liability Spillovers Onto Transportation/Aircraft Industry Companies. Only 1-year expected spillovers of $1 million or more calculated as at November 30, 2011, are shown.

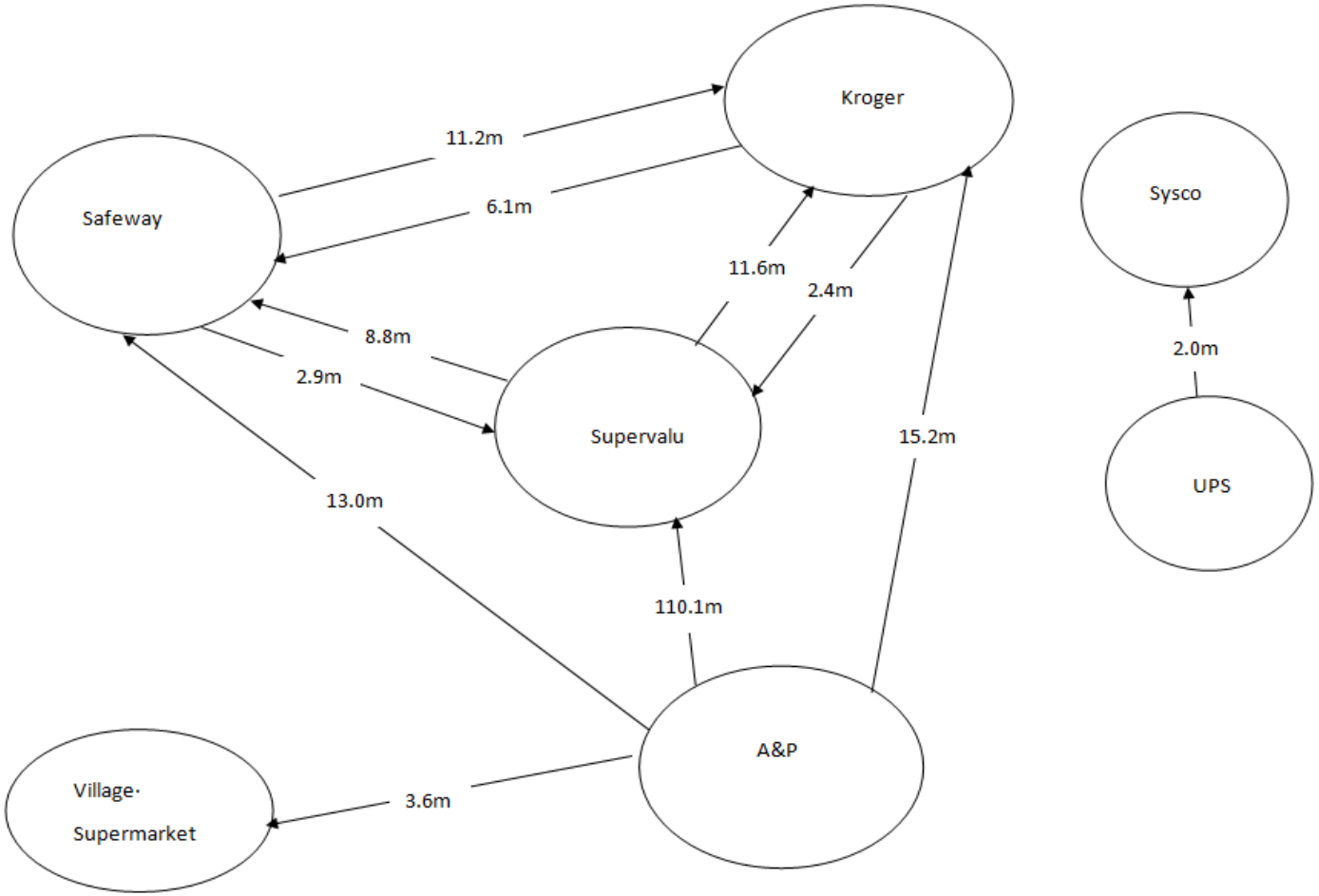

Figure 1.12. Sources of 1-Year Expected MDBP Liability Spillovers Onto Food/Retail/Drugs Companies. Only 1-year expected spillovers of $1 million or more calculated as at November 30, 2011, are shown.

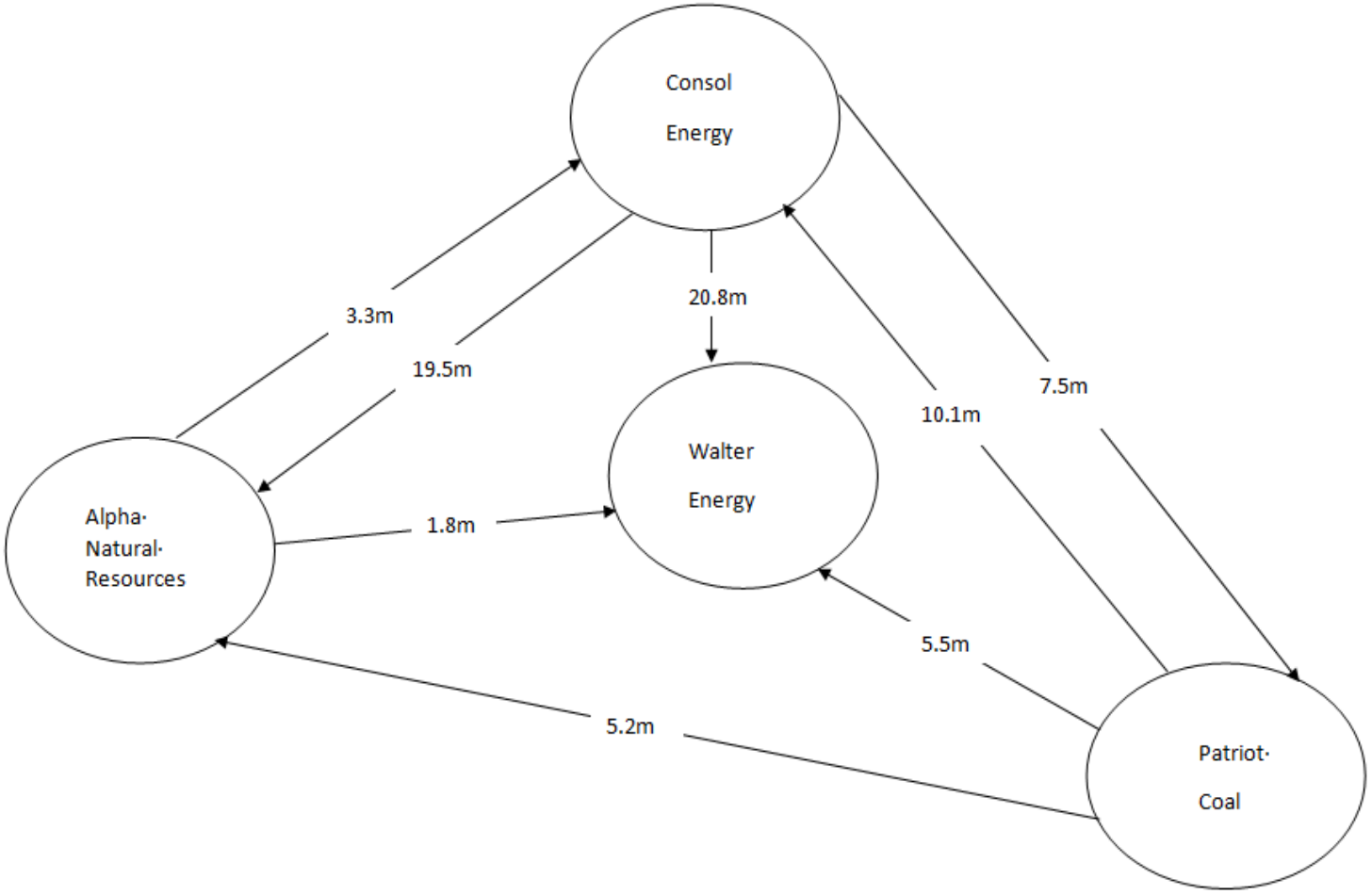

Figure 1.13. Sources of 1-Year Expected MDBP Liability Spillovers Onto Mines/Coal/Oil Companies. Only 1-year expected spillovers of $1 million or more calculated as at November 30, 2011, are shown.

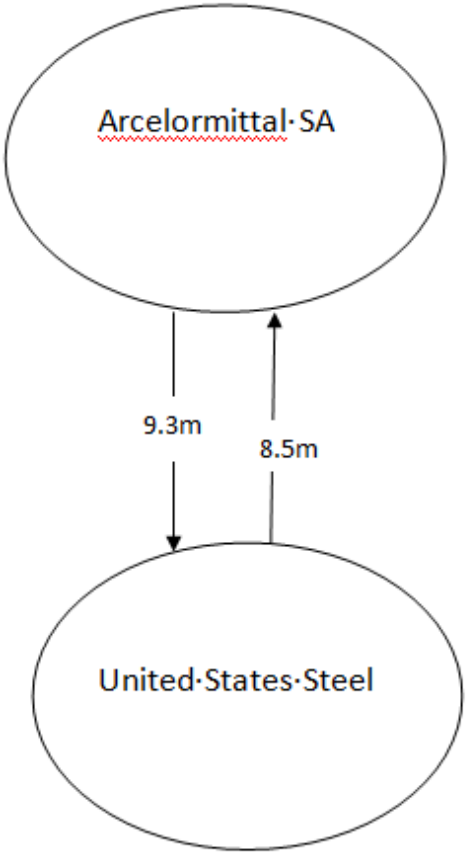

Figure 1.14. Sources of 1-Year expected MDBP Liability Spillovers Onto Construction/Engineering/Steel Companies. Only 1-year expected spillovers of $1 million or more calculated as at November 30, 2011, are shown.

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CHAPTER 2

DOES MULTIEMPLOYER DEFINED BENEFIT PENSION PLAN MEMBERSHIP INFLUENCE STOCK RETURN CO-MOVEMENT?

2.1 Introduction

A multiemployer pension plan is a collectively bargained pension plan supported by two or more employers and one labor union. For the 2010 plan year, there were 1,471 U.S active private Multiemployer defined benefit pension plans (MDBPs) with 10.6 million participants and $466 billion assets (U.S. Department of Labor Employee Benefits Security Administration, 2012). Depletion of MDBP assets during the financial crisis together with low interest rates used to discount MDBP liabilities resulted in unprecedented levels of aggregate MDBP underfunding (liabilities exceeding assets). At the beginning of the 2010 plan year, the aggregate value of MDBP vested pension benefits was $757 billion with an aggregate underfunding of $391 billion (Department of Labor, Department of the Treasury and PBGC, 2013). In contrast, the aggregate underfunding of single employer defined benefit plans of the S&P 1500 companies was $229 billion at year-end 2009 (Geisel, 2012). MDBPs exist in transient unionized industries such as construction, transportation, food, and retail to provide employees with portable pension benefits that can be transferred between employers in the same MDBP.

MDBP employers pool risks, contributions, assets, and liabilities and jointly govern MDBPs together with labor representatives. Companies can withdraw from MDBPs by paying their share of the MDBP's unfunded vested liabilities, but usually withdrawal liabilities are larger than the company's ongoing share of the MDBP's unfunded vested liabilities[31] and withdrawal may be onerous without the company's unionized employees' approval (Sanders, 2011). When a bankrupt company withdraws from a MDBP before or during the bankruptcy process, the MDBP withdrawal liability is a general unsecured claim. Generally, in the case of MDBP employer bankruptcy, total MDBP liabilities remain virtually constant,[32] but the number of contributing employers reduces, resulting in increased MDBP liabilities for the remaining nonbankrupt MDBP employers.

The Pension Benefit Guarantee Corporation (PBGC) does not assume a bankrupt company's MDBP assets and liabilities but only intervenes when MDBPs themselves become insolvent (unable to pay current benefits out of plan resources). Thus, MDBPs expose their participant companies to "liability spillover risks" from other companies in the same MDBP. In contrast, SDBPs do not produce liability spillovers onto other companies because the PBGC takes over SDBPs terminated in bankruptcy.

In this chapter, I examine whether MDBP membership influences company security returns' co-movement. I find that stock returns of MDBP sharing companies display positive statistically significant excess co-movement. I measure the MDBP co-movement of a stock by regressing its return against known risk factors and extracting the

[31] MDBP withdrawal liabilities must cover the whole of the company's share of the MDBP underfunding whereas when a company continues in a MDBP, employees shares some of the MDBP underfunding burden by relinquishing current wages, benefits or work rules (Moody's 2009).

[32] Anecdotal evidence suggests that in most cases, MDBPs recover a small percentage of their unsecured withdrawal liability claims.

residual. I then regress the residual against the returns of an index of stocks with whom the company shares MDBPs. I hypothesize that MDBP firms' stock returns move together more than can be explained by known risk factors such as macroeconomic factors and industry factors.

I find statistical evidence to suggest that MDBP sharing firms' stock returns co-movement changes after the public release of MDBP sharing firm information. I propose four common risk-based explanations for MDBP sharing companies' co-movement, namely: liability spillover risks (as described above), MDBP unfunded liability risks, labor contract risks, and geographic area risks. MDBPs expose each contributing company to unfunded liability risk because contributing companies must pay their share of the plan's unfunded liabilities upon withdrawal and active contributing employers must often address serious MDBP underfunding through increased MDBP contributions. MDBPs pool assets and liabilities exposing participating companies to the same asset investment risks and liability risks resulting in shared company exposure to MDBP unfunded liability risk. Multiemployer bargaining occurs when employers in the same industry form an association to negotiate with a single union (Employer withdrawal from multi-employer bargaining units: A proposal for self-regulation, 1982). Sanders (2011) explain that "Multiemployer contracts generally provide for uniform wages and benefits across an industry and locality for all association employers," (p.344) exposing MDBP sharing companies to shared labor contract risks. The majority of MDBPs cover a particular geographic area, e.g., The United Food and Commercial Workers (UFCW) Northern California Joint Pension, thus MDBP sharing companies usually share locations and thus geographic area risk exposure.

MDBPs must file Form 5500 annually to satisfy the 1974 Employee Retirement Income Security Act (ERISA) and IRS annual reporting requirements. For the 2009 plan year, for the first time MDBPs made mandatory disclosures on Form 5500 Schedule R about employers who contributed more than 5% of the total 2009 plan year MDBP contributions. I utilize the new Form 5500 Schedule R contributing employer information to construct a measure of each public companies expected MDBP liability spillovers from other public companies. I create an equallyweighted index of stocks with whom a company shares MDBPs and using this index, I investigate whether MDBP sharing companies' stock returns co-move more than can be explained by documented risk factors. I also create a spillover weighted MDBP index and a market value weighted MDBP index and use these indices to examine the co-movement of MDBP sharing companies' stock returns.

2.2 Hypothesis Development

Roll (1988) using one model for non-news date market-model error variance and a second higher variance model for news date market-model error variance finds that (1) minimum ratio of news variance to noise variance is around 20 for the full sample but only around seven for the non-news dates sample and (2) the estimated probability of news is 0.14 for the full sample and 0.18 for the non-news dates sample. Roll concludes that his results suggest that either private information exists or that infrequent noninformation driven frenzies occur.

Piotroski and Roulstone (2004) find that stock return synchronicity increases with analyst activity and decreases with insider information. The authors posit that analysts

increase the relative amount of market-wide and industry-level information in security prices and that insiders increase the relative amount of firm-specific information in security prices.

Before the public release of MDBP major contributing company information, insiders, unions, institutional investors, MDBP administrators, MDBP actuaries, and credit rating companies had private information on companies' MDBP liabilities and potential MDBP liability spillovers. Moody's (2006) provides public information on bond issuing companies' own MDBP liabilities. From the 10-K, the majority of investors could ascertain a firm's MDBP membership but information needed to estimate potential MDBP liability spillovers was unavailable. After the public release of MDBP major contributing company information, firm-specific MDBP information needed to estimate a firm's potential MDBP liability spillovers from other firms became public. The public release of MDBP major contributing company information increased the ratio of public information to private information for MDBP major contributing firms, changing investor's information regarding MDBP companies' shared systematic risk exposure. Therefore I hypothesize that the MDBP companies' stock return co-movement changed after the public release of MDBP major contributing company information.

If the 2009 plan year, Form 5500 revealed new public information about MDBP risks and MDBP associated risks are systematic risks then I expect that the MDBP index coefficient, γ, changed after the revelation of 2009 plan year Form 5500 information. I hypothesize that:

$$H_0: \gamma_{before}^{MDBP\_SPILL} = \gamma_{after}^{MDBP\_SPILL}$$
$$H_1: \gamma_{before}^{MDBP\_SPILL} \neq \gamma_{after}^{MDBP\_SPILL} \quad (2.1)$$

Rejecting the null hypothesis will provide evidence to suggest that the 2009 plan year Form 5500 revealed new public information about MDBP risks and MDBP associated risks are systematic risks. If I fail to reject the null hypothesis but the MDBP index coefficient is statistically significantly positive, then the statistical evidence suggests one of the two following caveats: (1) Market prices contained all MDBP information before the release of public MDBP information and/or (2) my event study methodology assumes constant risks; however, risks could change through time.

2.3 Literature Review

My study relates to four strands of literature: co-movement, default correlation, contagion effects, and the effects of single employer defined benefit pensions (SDBP) on asset pricing.

Pirinsky and Wang (2006) find strong co-movement amongst the stock returns of companies headquartered in the same geographic area. The authors find no evidence to support the hypothesis that local economic conditions affect the firms' fundamentals since same geographic area stocks' earnings processes do not co-move. A state-level monthly economic activity measure explains some of stocks' co-movement but its magnitude is insufficient to explain all of the local co-movement of stock returns. The authors find evidence supporting the geographic-segmentation explanation of local co-movement; they find stronger co-movement amongst stocks with a larger fraction of

local investors such as small stocks.

Ceteris paribus, expected MDBP liability spillovers result in increased firm default probabilities and increased correlations amongst default probabilities of MDBP sharing firms. Merton (1974) models equity as a call option on a firm's assets with the call's strike price equal to the value of the firm's liabilities. In the event of a firm in an underfunded MDBP filing for bankruptcy, the MDBP liabilities of nonbankrupt firms in the same MDBP frequently increase, decreasing the nonbankrupt MDBP firm's equity value.

Jarrow and Yu (2001) define counterparty risk as the risk that the default of a firm's counterparty might affect its own default probability and introduce default process interdependency to Lando's (1994, 1998) reduced form model[33] by including a jump process in the set of state variables. The authors examine two firm looping defaults whereby each firm holds the other firm's debt and show how counterparty risk increases default probability nonlinearly opposed to the no counterparty risk case. MDBPs expose contributing companies to "looped" liability spillover risks because MDBPs expose their contributing companies to each other's unfunded MDBP liabilities.

Frequently, MDBP contributing employers are competitors because they belong to the same industry in the same general location. Lang and Stulz (1992) define the contagion effect as the change in value of the bankrupt firm's competitors that cannot be characterized by the bankrupt firm's wealth distribution and define the competitive effect as the wealth gain experienced by competitors because the bankruptcy transmits information about the competitive positions of firms in the bankrupt firm's industry. The authors empirically

[33] Lando's model uses a doubly stochastic Poisson process to account for the dependency between credit and market risk.

disentangle the relative importance of the contagion and competitive effects for industries with different characteristics. For industries with a debt-to-asset ratio exceeding the sample median, the authors find that the value of the competitors' equity falls by 3% on average around the bankruptcy announcement, providing evidence that for highlyleveraged industries the contagion effect prevails. Whereas, in less competitive industries[34] with debt-to-asset ratio below the sample median, competitors' equity increases by 2.2% around the bankruptcy announcement, providing evidence that for less competitive lowleveraged industries, the competitive effect prevails.

Vassalou and Xing (2004) explain that one company's default may have a domino effect on other firms, resulting in a systematic component in default risk. Using Merton's (1974) model to measure default risk, the authors find evidence supporting the hypothesis that default risk has a systematic component and is priced in the cross-section of equity returns. Specifically, the authors find that the aggregate survival rate change[35] has a positive statistically significant risk premium when adding it as an explanatory variable to the Capital Asset Pricing Model and Fama and French's three factor model.

Das, Duffie, Kapadia, and Saita (2007) find evidence that default clustering in data cannot be fully explained by observable factors. Jorion and Zhang (2009), using simulation, demonstrate that counterparty risk raises a company's own default probability. The authors evaluate 500 company defaults generated first by a conventional factor model (unconditional 1-year default probability of 1% and a 0.20

[34] Less competitive industries are defined as industries where the Herfindahl index (a proxy for imperfect competition) is less than the sample median.
[35] Survival rate is defined as one minus the probability of default. Change in survival rate is defined as survival rate at time t minus the survival rate at time t-1.

pair-wise default correlation coefficient) and then by adding counterparty risk to the baseline model (three counterparties for each company with a 30% debt recovery rate). With counterparty risk, the default correlation increases to 0.0262 from a baseline default correlation of 0.0243. Moreover, the simulation results support the hypothesis that counterparty risk contributes to the fat tails observed in default distributions; with counterparty risk, the default distribution's 99.99th percentile increases from 115 to 127 defaults.

MDBP liability spillover risks and counterparty risks share many similar attributes, bankrupt MDBP contributing companies may increase the liabilities of other contributing MDBP sharing companies, increasing default correlation amongst MDBP sharing companies. Das et al. (2007) report that firms' exposure to common or correlated risk factor co-movement is a possible explanation for firm default clustering in time. My research documents co-movement amongst the stock returns of public MDBP sharing companies, lending support to the hypothesis that MDBP companies share exposure to common risk factors.

Jin, Merton, and Bodie (2006) find evidence of a positive relationship between SDBP pension risk and firm risk. The authors perform a panel regression of firm beta on SDBP beta and find that assuming a 0.18 pension liability beta, one unit of pension risk increases the firm risk by 1.33 to 1.51 units and assuming a 0.46 pension liability beta, one unit of pension risk increases the firm risk by 0.79 to 0.83 units.

Franzoni and Marin (2006) find that portfolios of companies with the most underfunded SDBPs earn lower returns than portfolios of companies with healthier SDBPs, the phenomena persists for five years after the large SDBP underfunding

appears. The most underfunded SDBP portfolio's risk-adjusted returns are significantly negative with a magnitude of approximately 10% annually.

2.4 Data Collection

First, I collect information on which public companies share MDBPs and then I construct a measure of public companies' expected MDBP liability spillovers from other public companies available to market participants on a monthly basis.

Form 5500 contains information on MDBP assets, liabilities, and employer contributions. From the 2009 plan year onwards, investors can estimate MDBP liabilities of major contributing companies using Form 5500 information; however, it is necessary to link subsidiaries to their parents in order to obtain good estimates of a public company's total MDBP liabilities. For fiscal years ending after December 15, 2011, investors can use 10-K information together with Form 5500 information to estimate public companies' MDBP liabilities. I download the 2009 Form 5500 (All) data from the Department of Labor website (http://www.dol.gov/ebsa/foia/foia-5500.html). I merge the 2009 Form 5500(All) data with the 2009 Form 5500 schedule H, schedule MB, and schedule R data using the MDBP filing's unique key. The downloaded dataset includes MDBPs, SDBPs, multiemployer plans, and direct filing entities; therefore, I select MDBPs with filing status not equal to 'processing_stopped'.[36] I select MDBPs with Schedule R attached because I require information on MDBP contributing employers. The 2009 MDBP datasets contains some filings prior to 2009 therefore I select plans with a 2009 MDBP valuation

[36] EFAST2 Program Management Office personnel informed me that the public could view 'filing_error' plan filings but not 'processing_stopped' plan filings.

year and missing valuation date plans with a 2009 form year begin date. In order to construct each contributing employers' MDBP unfunded liability, I need the MDBP total unfunded liability; therefore, I delete observations with either a missing Form 5500 Schedule R's RPA94 liability or a missing Form 5500 Schedule H's end of year net plan assets. MDBPs are uniquely identified by their employer identification number (EIN) and their plan number but may have multiple filings; in the case of multiple filings, I select the plan filing with the earliest filing date and contributing employer Schedule R information.

I identify and collect data on both public parent companies and their subsidiaries who contribute to MDBPs. Form 5500 schedule R lists both the contributing employer's name and the contributing employer's EIN. I wish to match Schedule R subsidiaries to their public parent companies. However, as Rauh et al. (2013) explain, subsidiaries may have a different EIN from its parent,

> Under the current IRS rules, subsidiaries that are at least 80% owned by the parent may elect to file consolidated income tax returns. But they can also choose to file taxes separately while still remaining consolidated with the parent company for financial purposes. In this case, the EIN and the sponsor name reported in Form 5500 will differ from its parent's. (p. 12)

In order to identify public parents of Schedule R companies, I follow Rauh et al. (2013) and match the Schedule R Company's EIN to public parent's EIN using COMPUSTAST EINs. For companies unmatched to a public parent using EINs, I use the Schedule R company name to search Hoover's database for potential public parents. Several companies may have the same name, so I use the MDBP industry and location to identify the correct Hoover's company.

When Hoover's lists a potential public parent for the Schedule R company, I search

for the Schedule R company name on Exhibit 21 (listing of active subsidiaries) of the potential public parent's 10-K[37]. When the Schedule R company does not appear on Exhibit 21, I search the rest of the public company's 10-K for the Schedule R company name. Public companies need only list in Exhibit 21 their "significant" subsidiaries who contribute more than 10% of consolidated assets or pretax income at the end of the last fiscal year (Lignon and Malm (2013)); therefore, if neither Exhibit 21 nor the remaining 10-K mention the Schedule R company, I ascertain whether the Schedule R company's website reveals that the company has a public parent. If I still cannot verify the Hoover's Schedule R company match to its public parent, I search the internet to ascertain whether the Schedule R company's EIN can be linked to a public company's pension plan. I also use einfinder.com to match Schedule R company's EINs with a public company. Lastly, I search the internet for court documents or news stories linking the Schedule R company to its public parent.

In order to be included in my sample, I require that MDBPs have at least one U.S. incorporated public firm listed on the NYSE, NASDAQ, or AMEX on the exchanges on the plan's filing date. In my sample, I require that the Schedule R company match to its Hoover's public parent can be verified by at least one of the methods outlined above in order to assign it to a public parent. I delete companies making a MDBP withdrawal liability payment. In the case of more than one public company observation for the same MDBP; I sum the pension contributions across observations and consolidate the public company information into one MDBP public company observation.

In order to collate expected MDBP liability spillover information available to

[37] I use the most recent public parent's 10-K available before the Form 5500 filing date.

market participants, I calculate expected MDBP liability spillovers from publicly available Form 5500 filings on a monthly basis from July 30, 2010, to November 30, 2011. I choose an initial date of July 30, 2010, because the date of the first 2009 plan year MDBP Form 5500 filing with at least two Schedule R public companies is July 28, 2010. I chose a final date of November 30, 2010, because for fiscal years ending after December 15, 2011 public companies must disclose their significant MDBPs in their 10-Ks.

I use the most recent publicly available MDBP information, when a MDBP files its 2010 plan year information before the end of the month; I replace the MDBP 2009 plan year information with the MDBP 2010 plan year information. I also add information from 2010 plan year MDBP filings for plans that are not included in my 2009 plan year data set but list at least one of the EINS associated with my 2009 plan year public companies in their 2010 plan year Schedule R. In order to calculate bankruptcy probabilities, I calculate Altman (1968) Z-scores from COMPUSTAT data with company fiscal year ends at least four months before the month's end date. I lag four months to ensure that the Z-score information was available to market participants at the month's end date.

2.5 Sample Selection

For the 2009 plan year, there are 4,902 first filing observations associated with 1,366 unique MDBPs. I delete 10 observations from the Pennsylvania Heavy and Highway Contractors Pension Trust because there are three observations for each of the five Schedule R employers with the same total employer contribution but different contributions rates. I delete one observation because the public company's MDBP

contribution is a withdrawal payment.

There are 1,389 observations, 333 unique MDBPs, and 529 public company observation for MDBPs with at least one U.S. incorporated public company listed on Schedule R. I lose 40 observations because I consolidate all public company observations in the same MDBP into one public company MDBP observation. My final 2009 plan year sample consists of 1,349 observations, 333 unique MDBPs, and 489 public company observations associated with 154 unique public companies with 144 U.S. incorporated public companies.

In order to examine expected spillover information disclosed to the market by Form 5550 filings through time, I calculate expected liability spillovers available from public Form 5500 information on a monthly basis. I have 17 month end-dates starting at July 30, 2010 and ending on November 30, 2011. I collect the most recently available Form 5500 information; therefore, I replace 189 2009 plan year MDBPs with their corresponding 2010 plan year MDBP. Twenty-three MDBPs no longer list any 2009 plan year public companies on their 2010 plan year Schedule R. I include 25 new 2010 plan year MDBPs which contain at least one Schedule R employer EIN associated with my 2009 plan year public companies where the 2009 plan year public company was not previously listed on the MDBP's 2009 plan year Schedule R.

In order to calculate expected liability spillovers, there must be at least two public companies listed on a MDBP's Schedule R and all public company bankruptcy probabilities must be nonmissing. A company must have at least one nonmissing one-year expected liability spillover to enter my co-movement sample, 84 companies meet this requirement. Using 2010 fiscal year information, I provide summary statistics for the

84 companies in my co-movement sample in Table 2.1. I collect stock return data from CRSP.

MDBP companies may be involved in mergers and acquisitions. When I initially match schedule R companies to public companies, I assign a Schedule R company to a public company at the 2009 plan year Form 5500 filing date. However, I wish to investigate MDBP sharing companies' stock return co-movement from June 2005 to November 2011 inclusive; I therefore search the SDC database for mergers and acquisitions during this period and I adjust my co-movement dataset accordingly.

2.6 Co-movement of MDBP Sharing Companies

I examine the co-movement of MDBP sharing firms five years before the revelation of the 2009 plan year Form 5500 information, during, and after the revelation of the 2009 plan year Form 5500 information from July 2010 to November 2011 inclusive. For each company's stock, I construct a MDBP spillover index by equal weighting the returns of stocks with whom the company shares MDBP(s). In my main analysis, I follow Pirinsky and Wang (2006) and use an equally weighted MDBP spillover index. I choose an equally weighted MDBP spillover index for my primary investigation because I do not have sufficient information to construct a spillover weighted MDBP spillover index before the public release of major MDBP contributing employer information.

For robustness checks, I also use MDBP spillover indices value weighted by market value and weighted by expected 1-year expected MDBP liability spillovers, in Chambers (2016); I explain how I calculate expected 1-year MDBP liability spillovers. For the spillover weighted MDBP spillover index, I use the expected MDBP spillover

onto the company from each of the stock index companies to weight the index's returns. For example, company A shares MDBP(s) with companies B, C, and D. Expected MDBP liability spillover onto company A are $2 million, $5 million, and $3 million from companies B, C, and D, respectively. I weight company B's stock return 0.2, company C's stock return 0.5, and company D's stock return 0.3, respectively. I regress public MDBP firms' stock returns on known risk factors and then regress the risk factor regression's residual on an index of the stock returns of companies with whom the firm shares MDBPs:

$$R_{i,t} = \alpha_i + \beta^{MKT} R_t^{MKT} + \epsilon_{i,t} \tag{2.2}$$

$$\epsilon_{i,t} = \varphi_i + \gamma_{-i}^{MDBP\_SPILL} R_{i,t}^{MDBP\_SPILL} + \mu_{i,t}$$

where $R_{i,t}$ is the monthly return of a particular MDBP firm's stock, $R_{i,t}^{MDBP\_SPILL}$ is the monthly return of the stock's corresponding MDBP index, and R_t^{MKT} is the monthly return of the stock market value-weighted index of all U.S. public stock returns. I calculate returns in excess of monthly T-bill rates. MDBP sharing firms are frequently in the same industry. In order to control for industry effects, I add an industry index of the stock's industry group to the risk factor regression. I use Fama and French's (1997) industry classifications to designate stocks into 48 industry groups. I estimate the following stock-level time-series regression:

$$R_{i,t} = \alpha_i + \beta^{MKT} R_t^{MKT} + R_t^{FF\_IND} + \epsilon_{i,t}$$

$$\epsilon_{i,t} = \varphi_i + \gamma_{-i}^{MDBP\_SPILL} R_{i,t}^{MDBP\_SPILL} + \mu_{i,t} \tag{2.3}$$

where $R_t^{FF\_IND}$ is the monthly return of the stock's Fama and French (1997) corresponding industry index. I also use CRSP two-digit SIC codes and four-digit SIC codes to assign stocks to their corresponding industry group and estimate the following two stock-level

time-series regressions. First, I use a two-digit SIC code (2SIC_IND) to construct the industry portfolio:

$$R_{i,t} = \alpha_i + \beta^{MKT} R_t^{MKT} + \beta^{2SIC\_IND} R_t^{2SIC\_IND} + \epsilon_{i,t}$$

$$\epsilon_{i,t} = \varphi_i + \gamma_{-i}^{MDBP\_SPILL} R_{i,t}^{MDBP\_SPILL} + \mu_{i,t} \quad (2.4)$$

Second, I use a four-digit SIC code (4SIC_IND) to construct the industry portfolio:

$$R_{i,t} = \alpha_i + \beta^{MKT} R_t^{MKT} + \beta^{4SIC\_IND} R_t^{4SIC\_IND} + \epsilon_{i,t}$$

$$\epsilon_{i,t} = \varphi_i + \gamma_{-i}^{MDBP\_SPILL} R_{i,t}^{MDBP\_SPILL} + \mu_{i,t} \quad (2.5)$$

In order to control for other known risk factors, I add the three Carhart (1997) factors to estimate the following three stock-level time-series regressions: First, I use Fama and French's (1997) 48 industry classifications (FF_IND) to construct the industry portfolio:

$$R_{i,t} = \alpha_i + \beta^{MKT} R_t^{MKT} + \beta^{FF\_IND} R_t^{FF\_IND} + \beta^{SMB} R_t^{SMB} + \beta^{HML} R_t^{HML} + \beta^{MOM} R_t^{MOM} + \epsilon_{i,t}$$

$$\epsilon_{i,t} = \varphi_i + \gamma_{-i}^{MDBP\_SPILL} R_{i,t}^{MDBP\_SPILL} + \mu_{i,t} \quad (2.6)$$

Second, I use a two-digit SIC code (2SIC_IND) to construct the industry portfolio:

$$R_{i,t} = \alpha_i + \beta^{MKT} R_t^{MKT} + \beta^{2SIC\_IND} R_t^{2SIC\_IND} + \beta^{SMB} R_t^{SMB} + \beta^{HML} R_t^{HML} + \beta^{MOM} R_t^{MOM} + \epsilon_{i,t}$$

$$\epsilon_{i,t} = \varphi_i + \gamma_{-i}^{MDBP\_SPILL} R_{i,t}^{MDBP\_SPILL} + \mu_{i,t} \quad (2.7)$$

Third, I use a four-digit SIC code (4SIC_IND) to construct the industry portfolio:

$$R_{i,t} = \alpha_i + \beta^{MKT} R_t^{MKT} + \beta^{4SIC\_IND} R_t^{4SIC\_IND} + \beta^{SMB} R_t^{SMB} + \beta^{HML} R_t^{HML} + \beta^{MOM} R_t^{MOM} + \epsilon_{i,t}$$

$$\epsilon_{i,t} = \varphi_i + \gamma_{-i}^{MDBP\_SPILL} R_{i,t}^{MDBP\_SPILL} + \mu_{i,t} \quad (2.8)$$

I estimate the time-series regressions (2.2) to (2.8) for the 17-month period from July 2010 to November 2011 inclusive with an equally weighted MDBP spillover index and I present the results in Table 2.2. The MDBP spillover index coefficient $\gamma^{EW\_MDBP\_SPILL}$ ranges from 0.012 to 0.094 across the seven models and is positively statistically significant in all models except for the two models using a four-digit SIC industry portfolio. Introducing a two-digit SIC industry factor reduces the magnitude of $\gamma^{EW\_MDBP\_SPILL}$ by almost one half (0.094 to 0.048) and also reduces the MDBP spillover index coefficient's statistical significance; however, the MDBP spillover index coefficient still remains positively statistically significant. I estimate the time-series regressions (2.2) to (2.8) for the 17-month period from July 2010 to November 2011 inclusive with a spillover weighted MDBP spillover index and market value weighted industry portfolios; I present the results in Table 2.3.

In most models, the magnitude of the spillover weighted MDBP spillover index coefficient $\gamma^{SW\_MDBP\_SPILL}$ is slightly smaller than its equally weighted counterpart but its statistical significance is very similar to its equally weighted counterpart. I estimate the time-series regressions (2.2) to (2.8) for the 17-month period from July 2010 to November 2011 inclusive with a market value weighted MDBP spillover index and market value weighted industry portfolios, I present the results in Table 2.4. In most models, the market value weighted MDBP spillover index coefficient $\gamma^{MW\_MDBP\_SPILL}$ is statistically insignificant.

MDBPs did not file contributing employer information before June 2010; therefore, I construct the pre June 2010 equally weighted MDBP spillover index using

the company weights as at September 2011 when all the 2009 plan year Form 5500 had filed. I estimate the time-series regressions (2.2) to (2.8) for the five-year period before the 2009 plan year MDBP filings and present the results in Table 2.5. The MDBP spillover index coefficient $\gamma^{\text{EW\_MDBP\_SPILL}}$ ranges from 0.069 to 0.219 across the seven models and is positively statistically significant in all seven models. Introducing a two-digit SIC industry factor reduces the magnitude of $\gamma^{\text{EW\_MDBP\_SPILL}}$ by 58% (0.219 to 0.092); however, the MDBP spillover index coefficient still remains positively statistically significant. Moreover, $\gamma^{\text{EW\_MDBP\_SPILL}}$ is statistically significant from zero with a four-digit SIC industry factor.

The equally weighted MDBP spillover index coefficient $\gamma^{\text{EW\_MDBP\_SPILL}}$ is almost twice the size and more positively significant before the public revelation of major MDBP employer contributors than after the public revelation of major MDBP employer contributors. In order to investigate this phenomenon further, I split the five-year period into three sub-periods: the pre-financial crisis period, the financial crisis period, and the post-financial crisis period. I present the time-series regressions (2.2) to (2.8) for the three sub-periods in Tables 2.6, 2.7, and, 2.8.

2.7 Cross-sectional Determinants of MDBP Company Stock Return Co-movement

I investigate the cross-sectional sources of MDBP co-movement in regard to firm and MDBP characteristics. First, I run the pair-wise regressions (2.9) and (2.10) during and after the revelation of 2009 plan year Form 5500 information from July 2010 to November 2011 inclusive and I extract the MDBP_SHARING_COMPANY beta.

Specifically, I regress MDBP contributing company stock returns against each of the stock returns of companies with whom it shares MDBPs. First, I use Fama and French's (1997) 48 industry classifications (FF_IND) to construct the industry portfolio:

$$R_{i,j,t} = \alpha_i + \beta_{i,j}^{\text{MDBP\_SHARING\_COMPANY}} R_{j,t}^{\text{MDBP\_SHARING\_COMPANY}} + \beta^{\text{MKT}} R_t^{\text{MKT}} + \beta^{\text{IND}} R_t^{FF\_IND} + \epsilon_{i,j,t} \quad (2.9)$$

Second, I use a two-digit SIC code (2SIC_IND) to construct the industry portfolio:

$$R_{i,j,t} = \alpha_i + \beta_{i,j}^{\text{MDBP\_SHARING\_COMPANY}} R_{j,t}^{\text{MDBP\_\_SHARING\_COMPANY}} + \beta^{\text{MKT}} R_t^{\text{MKT}} + \beta^{\text{IND}} R_t^{\text{2SIC\_IND}} + \epsilon_{i,i,t} \quad (2.10)$$

where $R_{j,t}^{\text{MDBP\_SHARING\_COMPANY}}$ is the monthly return of a company with which the dependent variable company shares MDBPs. I regress the MDBP_SHARING_COMPANY beta as the dependent variable against the following COMPUSTAT firm and MDBP characteristic independent variables:

- *Company_Spill*– the expected MDBP liability spillover from the independent company in the pair-wise regressions ((2.9) and (2.10)) onto the dependent company in the pair-wise regressions ((2.9) and (2.10)) as a percentage of the dependent company's market value of equity.
- *Size* – the natural logarithm of the market value of the stock.
- *Leverage*– the ratio of total debt over assets.
- *Market-to-Book* – the market-to-book equity ratio calculated as the market value of equity over the book value of equity.
- *ROA* – return on assets.
- *Same four-digit S*IC – an indicator variable set to one if the independent

company in the pair-wise regressions ((2.9) and (2.10)) has the same four-digit SIC code as the dependent company in the pair-wise regressions.

- *Z-score* – the negative Altman (1968) Z-score.

I average the above variables across the 17-month period (July 2010 to November 2011). Specifically, I run the cross-sectional regression:

$$\beta_{i,j}^{MDBP\_SHARING\_COMPANY} = \alpha_i + Company\_Spill_{i,j} + Size_i + Leverage_i + Market\_to\_Book_i + ROA_i + Same\_4digit\_SIC_i + Z\_Score_i + \varepsilon_{i,j,t} \quad (2.11)$$

In order to reduce dependency amongst the MDBP_SHARING_COMPANY betas, I split the sample into two sub-samples: betas where the dependent company is the most credit worthy (lowest Z-score) in the pair-wise regression (2.9) and (2.10) and betas where the dependent company is the least credit worthy (highest Z-score) in the pair-wise regressions (2.9) and (2.10). I present the results for regression (2.11) in Table 2.9. I note that the cross-sectional model (2.11) has no explanatory power for the most credit worthy company sub-sample and has very little explanatory power for the least credit worthy company sub-sample. Interestingly, for the least credit worthy sub-sample, the COMPANY_SPILL coefficient is negative and statistically significant.

2.8 Hypothesis Test Results

I hypothesize that:

$$H_0: \gamma_{before}^{MDBP\_SPILL} = \gamma_{after}^{MDBP\_SPILL}$$
$$H_1: \gamma_{before}^{MDBP\_SPILL} \neq \gamma_{after}^{MDBP\_SPILL} \quad (2.1)$$

I compare the spillover index coefficients from before the 2009 plan year revelation period (June 2005 to May 2010) and during and after the 2009 plan year revelation period (July 2010 to November 2011). I conduct a Welch's two sample t-test (Clogg, Petkova, & Haritou, 1995) to examine whether the MDBP index coefficient changes after the public release of MDBP contributing company information. I use the following test statistic:

$$t = \frac{\hat{\gamma}_{before}^{MDBP_{SPILL}} - \hat{\gamma}_{after}^{MDBP_{SPILL}}}{\sqrt{\frac{S_{\hat{\gamma}_{before}}^2}{N_{before}} + \frac{S_{\hat{\gamma}_{after}}^2}{N_{after}}}} \quad (2.12)$$

Welch's two sample t-test assumes that the two samples are independent however the two periods' samples may be correlated. I find extremely small correlations amongst the two periods' variables, the largest correlation magnitude is -0.0125, therefore, I believe that the independent sample assumption is reasonable. I summarize my results in Table 2.10 for the equally weighted MDBP index coefficient $\gamma^{\text{EW\_MDBP\_SPILL}}$ and equally weighted industry portfolios. Using the two sample t statistic, the MDBP index coefficients are statistically different from each other in six of the seven models.

I perform a robustness test whereby I equally weight the MDBP spillover index for during and after the 2009 plan year revelation period (July 2010 to November 2011) using the weights from September 2011 when all 2009 plan year MDBP information was publicly available. I present the results in Table 2.11. Using the two sample t statistic, the MDBP index coefficients are statistically different from each other in all models except the two models using a two-digit SIC industry portfolio.

I use a market value weighted MDBP index coefficient $\gamma^{\text{MW\_MDBP\_SPILL}}$ and market value weighted industry portfolios to conduct the two sample Welch t-test and I

summarize my results in Table 2.12. Using the two sample t statistic, the MDBP market value weighted index coefficients are statistically different from each other in only three of the seven models.

2.9 Conclusion

I find positively statistically significant excess co-movement amongst MDBP sharing companies. I propose four common risk-based explanations for MDBP sharing companies' co-movement, namely: liability spillover risks, MDBP unfunded liability risks, labor contract risks, and geographic area risks. Using an equally weighted MDBP index and equally weighted industry portfolios, six of my seven models provide statistical evidence to suggest that that MDBP sharing firm's excess co-movement changes after the public release of MDBP sharing firm information. However, using a market value weighted MDBP index and a market value weighted industry portfolios only three of my seven models provide statistical evidence to suggest that that MDBP sharing firm's excess co-movement changes after the public release of MDBP sharing firm information.

Table 2.1 Summary Statistics for MDBP Liability Spillover Companies

	N	Mean	Median	Minimum	Maximum	Standard Deviation	Skew
Market Value of Equity ($ millions)	84	17516.0	3504.0	91.0	194155.0	35864.0	3.4
Book Value of Total Assets ($ millions)	84	29386.0	6165.0	240.0	751216.0	88834.0	6.9
Market to Book Ratio	78	3.2	1.8	0.7	23.6	4.1	3.3
Leverage	83	0.9	0.9	0.3	1.5	0.3	0.6
Mean Expected Spillover ($ millions)	84	5.5	0.1	0.0	179.2	22.0	6.7
Maximum Expected Spillover ($ millions)	84	7.1	0.2	0.0	221.7	27.7	6.5
Mean Expected Spillover as a Percentage of Market Value of Equity (%)	84	0.5	0.0	0.0	25.9	2.9	8.6
Maximum Expected Spillover as a Percentage of Market Value of Equity (%)	84	0.6	0.0	0.0	32.0	3.6	8.6

Table 2.2 Spillover Co-movement July 2010 to November 2011 With an Equally Weighted Spillover Portfolio
(994 observations)

	$\gamma^{EW\_MDBP\_SPILL}$	β^{MKT}	$\beta^{EQ\_FF\_IND}$	$\beta^{EQ\_2SIC\_IND}$	$\beta^{EQ\_4SIC\_IND}$	β^{SMB}	β^{HML}	β^{MOM}
Model 1								
Parameter Estimate	0.094	1.368						
t-stat	2.74**	37.58***						
Model 2								
Parameter Estimate	0.060	0.269	0.877					
t-stat	2.17**	1.28	5.20***					
Model 3								
Parameter Estimate	0.048	0.197		0.937				
t-stat	2.07*	1.21		7.38***				
Model 4								
Parameter Estimate	0.013	0.217			0.877			
t-stat	0.57	2.57**			14.24***			
Model 5								
Parameter Estimate	0.055	0.434	0.980			-0.835	-0.050	0.215
t-stat	2.02*	2.56**	6.76***			-4.88***	-0.46	1.89*
Model 6								
Parameter Estimate	0.044	0.394		1.009		-0.830	0.016	0.242
t-stat	1.96*	2.54**		9.07***		-7.10***	0.13	2.91**
Model 7								
Parameter Estimate	0.012	0.341			0.882	-0.377	-0.006	0.077
t-stat	0.53	3.82***			14.37***	-3.60***	-0.08	1.55

*denotes statistical significance at the 10% level of significance **denotes statistical significance at the 5% level of significance
***denotes statistical significance at the 1% level of significance. I calculate t statistics using white standard errors clustered by date.

Table 2.3 Spillover Co-movement July 2010 to November 2011 With a Spillover Weighted Spillover Portfolio
(994 observations)

	$\gamma^{SW\_MDBP\_SPILL}$	β^{MKT}	$\beta^{EW\_FF\_IND}$	$\beta^{EW\_2SIC\_IND}$	$\beta^{EW\_4SIC\_IND}$	β^{SMB}	β^{HML}	β^{MOM}
Model 1								
Parameter Estimate	0.080	1.368						
t-stat	2.69**	37.58***						
Model 2								
Parameter Estimate	0.053	0.269	0.877					
t-stat	2.00*	1.28	5.20***					
Model 3								
Parameter Estimate	0.043	0.197		0.937				
t-stat	2.29**	1.21		7.38***				
Model 4								
Parameter Estimate	0.018	0.217			0.877			
t-stat	0.87	2.57**			14.24***			
Model 5								
Parameter Estimate	0.048	0.434	0.980			-0.835	-0.050	0.215
t-stat	1.77*	2.56**	6.76***			-4.88***	-0.46	1.89*
Model 6								
Parameter Estimate	0.038	0.395		1.009		-0.830	0.016	0.242
t-stat	2.02*	2.54**		9.07***		-7.10***	0.13	2.91**
Model 7								
Parameter Estimate	0.017	0.341			0.882	-0.377	-0.006	0.077
t-stat	0.79	3.82***			14.37***	-3.60***	-0.08	1.55

*denotes statistical significance at the 10% level of significance **denotes statistical significance at the 5% level of significance
***denotes statistical significance at the 1% level of significance. I calculate t statistics using white standard errors clustered by date.

Table 2.4 Spillover Co-movement July 2010 to November 2011 With a Market Value Weighted Spillover Portfolio
(994 observations)

	$\gamma^{MW\_MDBP\_SPILL}$	β^{MKT}	$\beta^{VW\_FF\_IND}$	$\beta^{VW\_2SIC\_IND}$	$\beta^{VW\_4SIC\_IND}$	β^{SMB}	β^{HML}	β^{MOM}
Model 1								
Parameter Estimate	0.104	1.376						
t-stat	3.03***	37.58***						
Model 2								
Parameter Estimate	0.048	0.353	0.935					
t-stat	1.73	3.28***	12.23***					
Model 3								
Parameter Estimate	0.037	0.354		0.935				
t-stat	1.20	3.56***		13.06***				
Model 4								
Parameter Estimate	-0.006	0.260			0.903			
t-stat	-0.23	4.64***			27.12***			
Model 5								
Parameter Estimate	0.049	0.466	0.953			-0.408	0.106	0.141
t-stat	1.90*	4.46***	12.84***			-3.32***	1.06	1.84*
Model 6								
Parameter Estimate	0.037	0.485		0.961		-0.497	0.173	0.162
t-stat	1.35	5.15***		12.82***		-3.76***	1.54	2.24**
Model 7								
Parameter Estimate	-0.005	0.351			0.904	-0.286	0.074	0.134
t-stat	-0.22	4.76***			27.04***	-1.92*	0.79	1.22

*denotes statistical significance at the 10% level of significance **denotes statistical significance at the 5% level of significance
***denotes statistical significance at the 1% level of significance. I calculate t statistics using white standard errors clustered by date.

Table 2.5 Spillover Co-movement June 2005 to May 2010 With an Equally Weighted Spillover Portfolio
(2,086 observations)

	$\gamma^{EW\_MDBP\_SPILL}$	β^{MKT}	$\beta^{EQ\_FF\_IND}$	$\beta^{EQ\_2SIC\_IND}$	$\beta^{EQ\_4SIC\_IND}$	β^{SMB}	β^{HML}	β^{MOM}
Model 1								
Parameter Estimate	0.219	1.420						
t-stat	6.33***	11.51***						
Model 2								
Parameter Estimate	0.131	0.135	0.963					
t-stat	7.33***	0.79	7.16***					
Model 3								
Parameter Estimate	0.092	-0.038		1.098				
t-stat	6.08***	-0.23		8.19***				
Model 4								
Parameter Estimate	0.074	0.178			0.926			
t-stat	3.53***	2.36**			13.12***			
Model 5								
Parameter Estimate	0.129	0.106	0.937			0.007	0.130	-0.049
t-stat	7.78***	0.67	7.12***			0.04	1.05	-0.99
Model 6								
Parameter Estimate	0.091	-0.058		1.098		-0.101	0.073	-0.030
t-stat	6.17***	-0.36		7.96***		-0.53	0.60	-0.58
Model 7								
Parameter Estimate	0.069	0.119			0.911	0.147	0.020	-0.084
t-stat	4.22***	1.35			13.97***	1.35	0.21	-1.70

*denotes statistical significance at the 10% level of significance **denotes statistical significance at the 5% level of significance
***denotes statistical significance at the 1% level of significance. I calculate t statistics using white standard errors clustered by date

Table 2.6 Spillover Co-movement June 2005 to July 2007 With an Equally Weighted Spillover Portfolio
(1,655 observations)

	$\gamma^{EW\_MDBP\_SPILL}$	β^{MKT}	$\beta^{Ew\_FF\_IND}$	$\beta^{EQ\_2SIC\_IND}$	$\beta^{EQ\_4SIC\_IND}$	β^{SMB}	β^{HML}	β^{MOM}
Model 1								
Parameter Estimate	0.240	1.395						
t-stat	6.32***	19.07***						
Model 2								
Parameter Estimate	0.144	0.347	0.794					
t-stat	5.70***	2.20**	10.96***					
Model 3								
Parameter Estimate	0.121	0.355		0.809				
t-stat	5.04***	2.53***		13.12**				
Model 4								
Parameter Estimate	0.091	0.379			0.780			
t-stat	4.05***	4.18**			18.84***			
Model 5								
Parameter Estimate	0.142	0.370	0.841			-0.192	-0.133	-0.025
t-stat	5.31***	2.50**	9.61***			-1.26	-1.20	-0.28
Model 6								
Parameter Estimate	0.116	0.384		0.863		-0.231	-0.241	-0.025
t-stat	4.53***	2.97**		12.74***		-1.76*	-2.28**	-0.31
Model 7								
Parameter Estimate	0.090	0.392			0.786	-0.049	-0.159	-0.075
t-stat	3.87***	4.34			18.25***	-0.52	-1.69	-1.15

*denotes statistical significance at the 10% level of significance **denotes statistical significance at the 5% level of significance
***denotes statistical significance at the 1% level of significance. I calculate t statistics using white standard errors clustered by date.

Table 2.7 Spillover Co-movement August 2007 to December 2009 With an Equally Weighted Spillover Portfolio
(1,181 observations)

	$\gamma^{EW\_MDBP\_SPILL}$	β^{MKT}	$\beta^{EQ\_FF\_IND}$	$\beta^{EQ\_2SIC\_IND}$	$\beta^{EQ\_4SIC\_IND}$	β^{SMB}	β^{HML}	β^{MOM}
Model 1								
Parameter Estimate	0.285	1.276						
t-stat	5.71***	14.38***						
Model 2								
Parameter Estimate	0.161	-0.014	1.047					
t-stat	5.85***	-0.14	13.21***					
Model 3								
Parameter Estimate	0.122	-0.119		1.169				
t-stat	6.16***	-0.79		10.74***				
Model 4								
Parameter Estimate	0.070	0.059			1.017			
t-stat	3.56***	0.57			14.58***			
Model 5								
Parameter Estimate	0.152	-0.108	1.058			0.007	-0.620	-0.327
t-stat	6.18***	-0.90	11.28***			0.04	-5.75***	-6.20***
Model 6								
Parameter Estimate	0.112	-0.209		1.195		-0.196	-0.547	-0.364
t-stat	6.29***	-1.52		10.33***		-1.02	-5.11***	-5.88***
Model 7								
Parameter Estimate	0.067	0.024			1.011	0.005	-0.287	-0.170
t-stat	3.40***	0.28			13.79***	0.05	-2.61**	-3.22***

*denotes statistical significance at the 10% level of significance.**denotes statistical significance at the 5% level of significance
***denotes statistical significance at the 1% level of significance. I calculate t statistics using white standard errors clustered by date.

Table 2.8 Spillover Co-movement January 2009 to May 2010 With an Equally Weighted Spillover Portfolio
(1,255 observations)

	$\gamma^{EW\_MDBP\_SPILL}$	β^{MKT}	$\beta^{EW\_FF\_IND}$	$\beta^{EW\_2SIC\_IND}$	$\beta^{EW\_4SIC\_IND}$	β^{SMB}	β^{HML}	β^{MOM}
Model 1								
Parameter Estimate	0.186	1.562						
t-stat	3.23***	7.09***						
Model 2								
Parameter Estimate	0.112	0.197	1.03					
t-stat	4.14***	0.65	4.20***					
Model 3								
Parameter Estimate	0.064	-0.084		1.219				
t-stat	2.82**	-0.27		4.94***				
Model 4								
Parameter Estimate	0.071	0.258			0.929			
t-stat	2.04**	2.10*			7.35***			
Model 5								
Parameter Estimate	0.108	0.063	0.983			0.142	0.265	-0.032
t-stat	4.35***	0.19	3.50***			0.44	2.09*	-0.50
Model 6								
Parameter Estimate	0.063	-0.180		1.224		-0.003	0.195	0.021
t-stat	2.65**	-0.57		4.36***		-0.01	1.48	0.35
Model 7								
Parameter Estimate	0.059	0.104			0.902	0.381	0.091	-0.101
t-stat	2.44**	0.66			7.61***	1.98*	0.95	-2.47**

*denotes statistical significance at the 10% level of significance. **denotes statistical significance at the 5% level of significance
***denotes statistical significance at the 1% level of significance. I calculate t statistics using white standard errors clustered by date.

Table 2.9 Cross-Sectional Determinants for MDBP Sharing Companies' Co-movement July 2010 to November 2011
(1) Full Sample (2) Influential Observations Deleted (Cook's Distance greater than one)

	FF48 Industry Portfolio				**Two-digit SIC Industry Portfolio**			
	Least Creditworthy		***Most Creditworthy***		***Least Creditworthy***		***Most Creditworthy***	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Intercept	0.933	0.988	3.308	4.054	1.005	1.074	2.512	3.050
t stat	1.52	1.62	1.43	1.38	1.82*	1.99**	1.10	1.05
Company_Spill	-0.140	-4.041	0.022	-2.535	-0.139	-5.049	0.004	-1.840
t stat	-1.72*	-2.35**	0.97	-1.12	-1.83*	-2.73***	0.22	-0.83
Size	0.009	0.011	-0.331	-0.381	-0.009	-0.007	-0.211	-0.247
t stat	0.14	0.16	-1.36	-1.34	-0.14	-0.11	-0.88	-0.88
Leverage	-0.613	-0.681	1.906	1.668	-0.519	-0.605	1.1764	1.593
t stat	-1.77*	-2.06**	-1.36	1.05	-1.33	-1.87*	0.98	0.99
Market-to-Book	-0.022	-0.021	-0.121	-0.085	-0.018	-0.9	-0.088	-0.062
t stat	-1.16	-1.11	-1.14	-1.08	-0.95	-1.16	-0.84	-0.80
ROA	-3.266	-6.272	15.39	14.432	-2.491	-6.273	9.299	8.608
t stat	-1.07	-1.69*	1.45	1.46	-0.77	-2.60***	0.90	0.90
Same four-digit SIC	0.25	0.235	-0.423	-0.431	0.002	-0.017	-0.625	-0.624
t stat	1.10	0.98	-0.84	-0.82	0.01	-0.07	-1.21	-1.20
Negative Altman Z-score	0.128	0.079	0.488	0.509	0.183	0.123	0.479	0.495
t stat	1.69*	1.11	1.35	1.35	1.98**	1.43	1.33	1.32
Number of Observations	87	86	97	96	87	86	97	96
Adjusted R^2	0.045	0.102	-0.040	-0.038	0.052	0.162	-0.049	-0.049

*denotes statistical significance at the 10% level of significance **denotes statistical significance at the 5% level of significance
***denotes statistical significance at the 1% level of significance. I calculate t statistics using white standard errors clustered by date.

Table 2.10 Comparison of MDBP Spillover Index Coefficients With an Equally Weighted Spillover MDBP Portfolio

	$\gamma_{before}^{EQ\_MDBP\_SPILL}$	$\gamma_{after}^{EQ\_MDBP\_SPILL}$	**Two sample t-test for MDBP Index Coefficient Equality t value**
Model 1	0.219	0.094	2.56**
Model 2	0.131	0.060	2.16**
Model 3	0.092	0.048	1.57
Model 4	0.074	0.013	2.02**
Model 5	0.129	0.055	2.30**
Model 6	0.091	0.044	1.73*
Model 7	0.069	0.012	2.05**

* denotes statistical significance at the 10% level of significance.
** denotes statistical significance at the 5% level of significance.
*** denotes statistical significance at the 1% level of significance.

Table 2.11 Comparison of MDBP Spillover Index Coefficients With an Equally Weighted Spillover MDBP Portfolio using September 2011 Weights

	$\gamma_{before}^{EQ\_MDBP\_SPILL}$	$\gamma_{after}^{EQ\_MDBP\_SPILL}$	**Two sample t-test for MDBP Index Coefficient Equality t value**
Model 1	0.219	0.111	2.32**
Model 2	0.131	0.074	1.81*
Model 3	0.092	0.061	1.18
Model 4	0.074	0.020	1.85*
Model 5	0.129	0.070	1.95*
Model 6	0.091	0.057	1.34
Model 7	0.069	0.019	1.92*

* denotes statistical significance at the 10% level of significance.
** denotes statistical significance at the 5% level of significance.
*** denotes statistical significance at the 1% level of significance

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Table 2.12 Comparison of MDBP Spillover Index Coefficients With a Market Value Weighted Spillover MDBP Portfolio

	$\gamma_{before}^{MW\_MDBP\_SPILL}$	$\gamma_{after}^{MW\_MDBP\_SPILL}$	**Two sample t-test for MDBP Index Coefficient Equality t value**
Model 1	0.219	0.104	2.35**
Model 2	0.134	0.048	2.24**
Model 3	0.070	0.037	0.94
Model 4	0.025	-0.006	1.06
Model 5	0.118	0.049	2.32**
Model 6	0.059	0.037	0.70
Model 7	0.016	-0.005	0.83

* denotes statistical significance at the 10% level of significance.
** denotes statistical significance at the 5% level of significance.
*** denotes statistical significance at the 1% level of significance

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APPENDIX

A.1 Calculation of an Individual MDBP's Unfunded Liabilities

I give a numerical example showing the calculation of an individual MDBP's unfunded liabilities:

Plan Data	**($ in millions)**
RPA 94 Liability	8,000
Current Value of Net Assets	6,000

MDBP's unfunded liability=

0.9 x (RPA 94 Liability-Current Value of Net Assets) x 0.5

= 0.9 x (8,000 - 6,000) x 0.5 = $900 million

A.2 Calculation of Company's Share of MDBP Unfunded Liabilities

I give a numerical example showing the calculation of three schedule R companies' share of the MDBP unfunded liabilities:

Total Employer Contributions	$100 million
Schedule R Data	**($ millions)**
Company A's contributions	40
Company B's contributions	20
Company C's contributions	25

Schedule R Company's share of MDBP unfunded liabilities=

Company's contributions/ Max (Schedule MB Total Employer Contributions, Schedule R Total Employer Contributions)

Company A's share of MDBP unfunded liabilities=40/100=40%

Company B's share of MDBP unfunded liabilities=20/100=20%

Company C's share of MDBP unfunded liabilities=25/100=25%

I estimate a company's individual plan MDBP ongoing[38] liabilities by multiplying the company's share of the MDBP unfunded liabilities by the MDBP's unfunded liabilities. I give a numerical example showing the calculation of each Schedule R company's share of the MDBP liability:

MDBP Plan Unfunded Liabilities	$900 million
Company Share	
Company A	40%
Company B	20%
Company C	25%

Company A's share of MDBP Unfunded liabilities =

Company A's share x MDBP Unfunded Liabilities = 40% of $900 million=$360 million

Company B's share of MDBP liabilities =

Company B's share x MDBP Unfunded Liabilities = 20% of $900 million =$180 million

Company C's share of MDBP liabilities =

Company C's share x MDBP Unfunded Liabilities =25% of $900 million =$225 million

[38] My estimate of a firm's individual MDBP liabilities is not an estimate of the firm's withdrawal liability but rather an estimate of the firm's ongoing MDBP liability. Moody's (2009) explain that a MDBP withdrawal liability will nearly always be higher than the firm's current share of the unfunded MDBP liability. When withdrawing from a MDBP, a firm will not benefit from wage concessions from labor.

A.3 Calculating LMS MDBP Liabilities in the Three Public Company Case

I give a numerical example showing how I calculate LMS MDBP liability spillovers for Company A when three public companies are listed on the MDBP Form 5500 Schedule R.

	($ millions)
Total Employer Contributions	100
Company A's contributions	40
Company B's contributions	20
Company C's contributions	25
Company A's share of MDBP liabilities	360
Company B's share of MDBP liabilities	180
Company C's share of MDBP liabilities	225

A's new share of MDBP unfunded liabilities upon B and C's bankruptcy = Company A's plan year contributions divided by the total employer contributions minus the sum of company B's and company C's contributions) = 40 / (100- (20+25)) = 8/11

LMS Liability Spillover onto Company A in the event that both Company B and Company C become bankrupt = Company A's new share of MDBP liabilities x sum of Company B's and Company C's MDBP liability = 8/11 x (180+225) = $294.6 million

A.4 Calculating 1-year Expected MDBP Liabilities in the Two Public Company Case

I give a numerical example showing how I calculate 1-year expected MDBP liability spillovers when there are two public companies listed on the MDBP Form 5500 Schedule R:

	($ millions)
Total Employer Contributions	100
Company A's contributions	40
Company B's contributions	20
Company A's share of unfunded MDBP liabilities	360
Company B's share of unfunded MDBP liabilities	180
Company A's bankruptcy probability	0.1
Company B's bankruptcy probability	0.2

A's new share of MDBP unfunded liabilities upon B's bankruptcy =

Company A's contributions / (Total Employer Contributions– Company B's contributions) =40/ (100-20) =0.5

Company A's expected liability spillover from company B =A's new share of MDBP liabilities x B's MDBP liability x B's bankruptcy probability x Complement of A's bankruptcy probability = 0.5 x 180 x 0.2 x (1-0.1) =$16.2 million

B's new share of MDBP unfunded liabilities upon A's bankruptcy =

Company B's contributions / (Total Employer Contributions – Company A's contributions) = 20/ (100-40) =1/3

Company B's expected liability spillover from company A = B's new share of MDBP liabilities x A's own MDBP liability x A's bankruptcy probability x Complement of B's bankruptcy

probability= 1/3 x 360 x 1/3 x 0.1x (1-0.2) =$ 9.6 million

A.5 Calculating 1-year Expected MDBP Liabilities in the Three Public Company Case

When there are three public companies listed on the MDBP Form 5500 Schedule R, I calculate the 1-year expected MDBP liability spillover onto company A from companies B and C as follows:

Expected MDBP liability spillover onto company A=

Expected Liability Spillover when only company B goes bankrupt +

Expected Liability Spillover when only company C goes bankrupt +

Expected Liability Spillover when both companies B and C go bankrupt

I give a numerical example illustrating how I calculate 1-year expected MDBP liability spillovers for Company A when three public companies are listed on the MDBP Form 5500 Schedule R.

	($ millions)
Total Employer Contributions	100
Company A's contributions	40
Company B's contributions	20
Company C's contributions	25
Company A's share of MDBP liabilities	360
Company B's share of MDBP liabilities	180
Company C's share of MDBP liabilities	225
Company A's bankruptcy probability	0.1

Company B's bankruptcy probability	0.2
Company C's bankruptcy probability	0.3

I calculate expected MDBP liability spillovers for the three different outcomes: only Company B goes bankrupt, only Company C goes bankrupt and both Company B and Company C go bankrupt.

A.5.1 Only Company B Goes Bankrupt

A's new share of MDBP unfunded liabilities upon B's bankruptcy =

Company A's contributions / (Total Employer Contributions – Company B's MDBP Contributions) = 40 / (100-20) = 0.5

Expected Liability Spillover onto Company A in the event that only Company B goes bankrupt

= Company A's new share of MDBP liabilities x Company B's MDBP liability x Company B's bankruptcy probability x Complement of Company C's bankruptcy probability x Complement of Company A's bankruptcy probability = 0.5 x 180 x 0.2 x (1-0.3) x (1-0.1) = $11.34 million

A.5.2 Only Company C Goes Bankrupt

A's new share of MDBP unfunded liabilities upon C's bankruptcy = Company A's contributions / (Total Employer Contributions– Company C's MDBP contributions)

= 40 / (100-25) = 8/15.

Expected Liability Spillover onto Company A in the event that only Company C goes bankrupt = Company A's new share of MDBP liabilities x Company C's MDBP liability x Company C's bankruptcy probability x Complement of Company B's bankruptcy probability x Complement of Company A's bankruptcy probability

= 8/15 x 225 x 0.3 x (1-0.2) x (1-0.1) = $25.92 million

A.5.3 Company B and Company C Goes Bankrupt

A's new share of MDBP unfunded liabilities upon B and C's bankruptcy =

Company A's plan year contributions divided by the total employer contributions minus the sum of company B's and company C's contributions) = 40 / (100- (20+25)) = 8/11

Expected Liability Spillover onto Company A in the event that both Company B and Company C become bankrupt = Company A's new share of MDBP liabilities x sum of Company B's and Company C's MDBP liability x Company B's bankruptcy probability x Company C's bankruptcy probability x Complement of Company A's bankruptcy probability = 8/11 x (180+225) x 0.3 x 0.2 x (1-0.1) = $15.90545 million

A.5.4 Company A's Total 1-year Expected MDBP Liability Spillover

Outcome	***($ millions)***
Only Company B goes bankrupt	11.34
Only Company C goes bankrupt	25.92
Company B and C goes bankrupt	15.90545
Total	53.17